august 1957

nlgi spokesman

journal of the national lubricating grease institute

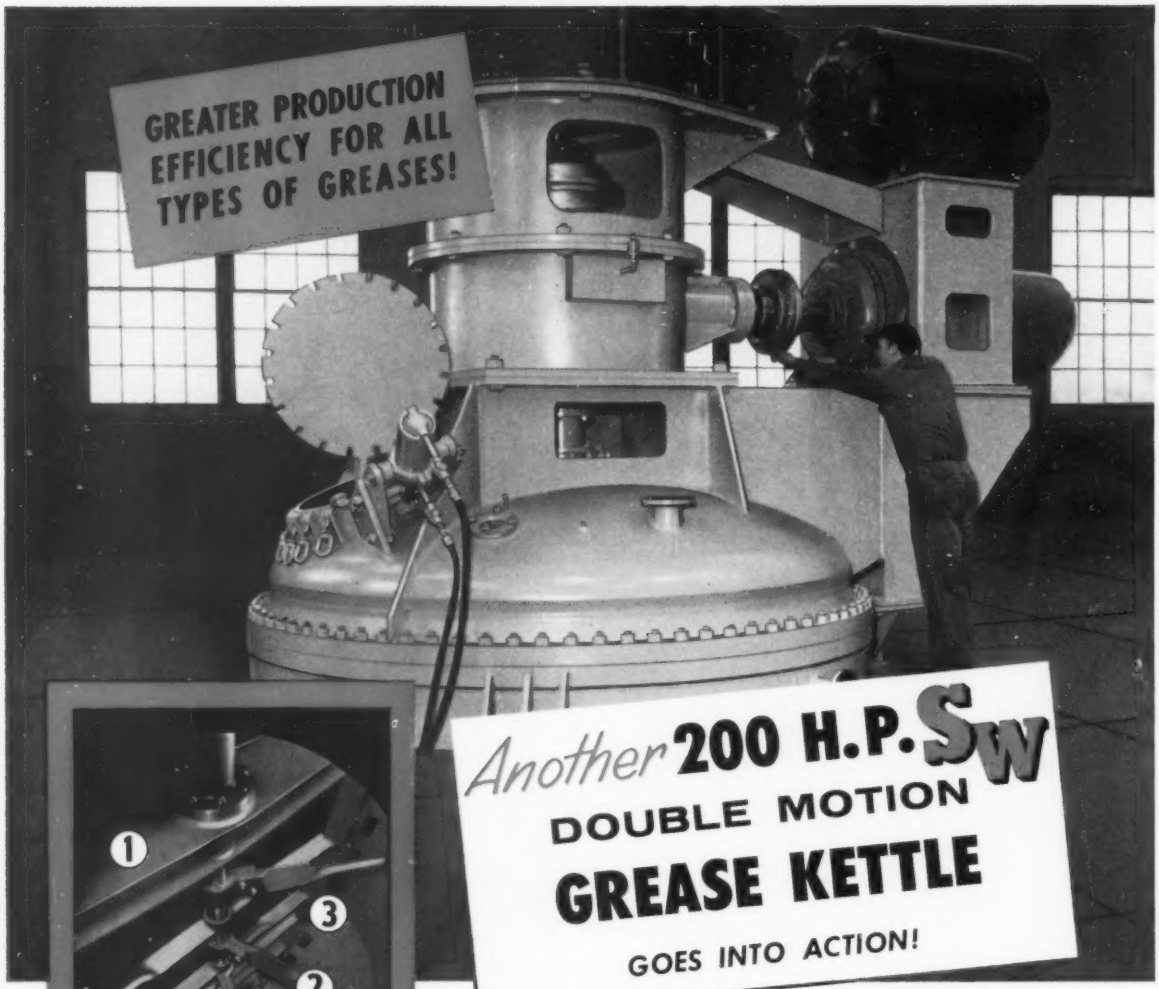
Infrared Studies of Bentone Grease – Water Systems
By E. C. MILBERGER, A. F. MILLER and V. R. DAMERELL

A Method for the Prediction of the Hardness Changes of Greases in Storage
By G. W. ECKERT

The Grease Cartridge
By C. E. GORE

Prolific Inventor Procures 150th U. S. Patent

NLGI Annual Meeting Previews



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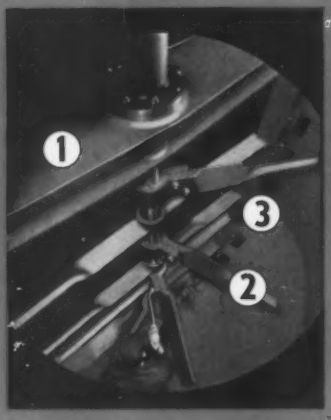

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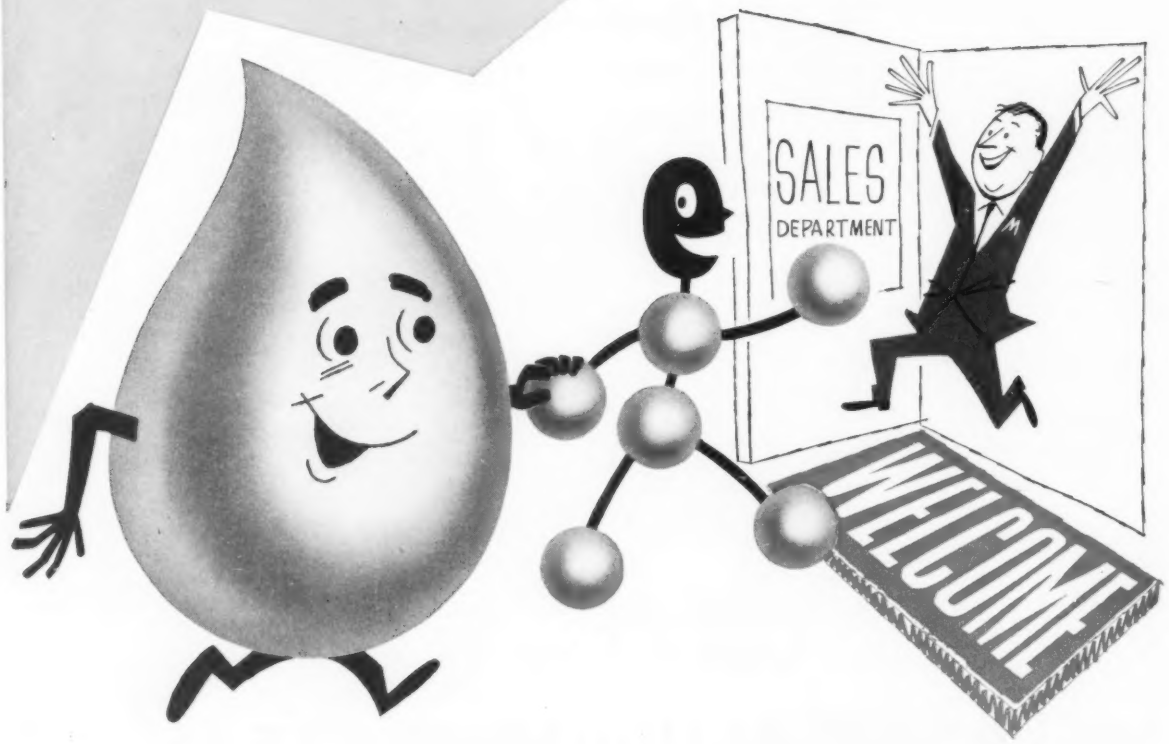

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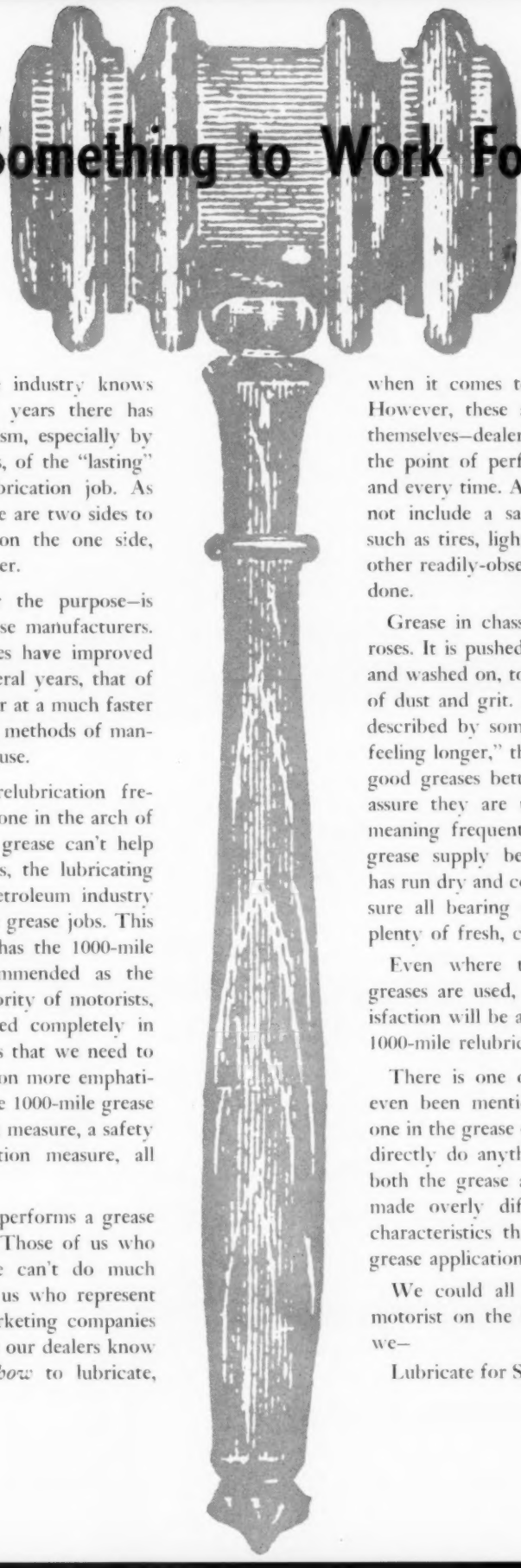
Something to Work For

THE PRESIDENT'S PAGE

By J. W. LANE
NLGI
President



The lubricating grease industry knows that over the past few years there has been an increasing criticism, especially by automotive manufacturers, of the "lasting" qualities of a chassis lubrication job. As with most criticisms, there are two sides to the coin—chassis grease on the one side, how it is used on the other.

Quality—suitability for the purpose—is the responsibility of grease manufacturers. We believe chassis greases have improved a lot during the past several years, that of late they are getting better at a much faster rate as new materials and methods of manufacture have come into use.

We think too that relubrication frequency is really the keystone in the arch of riding quality. The best grease can't help if it isn't used. For years, the lubricating grease people and the petroleum industry have advocated 1000-mile grease jobs. This has been a goal, just as has the 1000-mile engine oil change recommended as the best practice for the majority of motorists, but it hasn't been reached completely in either case. It seems to us that we need to redirect motorists' attention more emphatically to the benefits of the 1000-mile grease job. It is a wear-reduction measure, a safety measure, and a satisfaction measure, all rolled into one.

How a service station performs a grease job is just as important. Those of us who only manufacture grease can't do much about this, but those of us who represent integrated petroleum marketing companies had better make sure that our dealers know *what* to lubricate and *how* to lubricate, when it comes to the chassis grease job. However, these are not quite enough in themselves—dealers must be interested to the point of performing a good job each and every time. And, a grease job that does not include a safety inspection of items such as tires, lights, windshield wipers and other readily-observed points is only partly done.

Grease in chassis fittings has no bed of roses. It is pushed on, pulled on, rained on and washed on, to a steady accompaniment of dust and grit. If it is to do a good job, described by some as "that just-lubricated feeling longer," then let's continue to make good greases better *and* do all we can to assure they are used properly, the latter meaning frequently enough to renew the grease supply before a lubrication point has run dry and correct application to make sure all bearing points are supplied with plenty of fresh, clean grease.

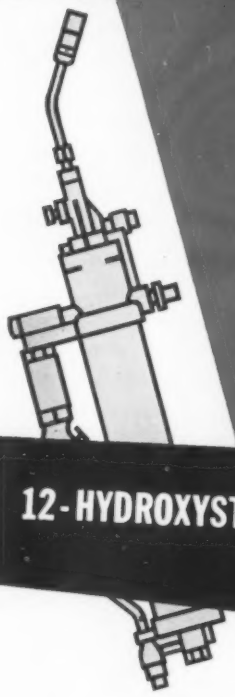
Even where the newer super chassis greases are used, continuing customer satisfaction will be achieved most easily if the 1000-mile relubrication principle is applied.

There is one other factor that has not even been mentioned, mostly because no one in the grease or petroleum industry can directly do anything about it. The job of both the grease and the "greaser" can be made overly difficult by vehicle design characteristics that work against effective grease application and functioning.

We could all work harder to sell the motorist on the benefits he will derive if we—

Lubricate for Safety Every 1000 Miles!

Baker



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Loss of Hydroxyl Value (6 hrs. at 285° F)	NEGLIGIBLE	27%	NEGLIGIBLE

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News About NLGI

Final Changes Before Film Distribution

"Grease – the Magic Film," NLGI's new movie, is just about ready for distribution to the first group of purchasers. Final modifications were made by the Film Committee at a showing in New York last month, and production of prints had begun at this writing.

Initial distribution for "Grease–the Magic Film" is through those firms owning prints, and to allow showings by print owners for some six months after the premiere, at the NLGI Annual Meeting in Chicago, October 28-30. The NLGI national office will then book public showings in those areas where print owners cannot serve.

Invite Purchases

Those organizations desiring to purchase the film may still do so at the same prices . . . the free title

service is no longer available, however. A title mentioning the name of the print owner may be obtained through the national office at nominal charge . . . these will be spliced, and not an integral part of the film as in the case of the original production orders.

Print prices are $600 for the first print, $400 for the second and $200 for the third and subsequent prints (non-members merely add $100 to each price category). The 25-minute sound film in 16-mm color may be ordered through the national office at any time.

Kolfenbach

Leland

Finlayson

NLGI Technical and Company Representative Changes

Esso Research and Engineering company's Dr. H. L. Leland, formerly technical representative to NLGI, is now assuming duties within his company other than research and development studies on greases, and will no longer retain his technical committee membership. Dr. J. J. Kolfenbach has assumed the technical committee duties for Esso and will act as their official technical representative to NLGI. Both men have contributed technical articles for publication in the NLGI SPOKESMAN and Leland was moderator of the forum on lubrication of ball bearings during NLGI annual meeting, Oct., 1956.

Baroid division of the National Lead company has named their manager of Bentone sales, Mr. C. Malcolm Finlayson, as NLGI Company Representative.

NLGI (Proposed) Lubricating Grease Production Survey

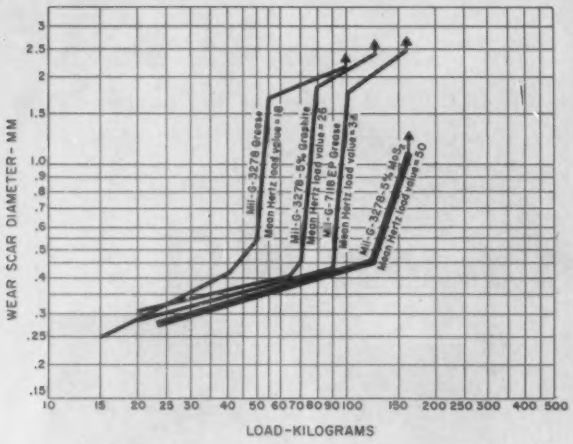
	Pounds Produced/Year	
Thickener*	Less Than 390 Worked Penetration	Greater Than 390 Worked Penetration
Sodium Soap	X	X
Calcium Soap	X	X
Lithium Soap	X	X
Barium Soap	X	X
Aluminum Soap	X	X
Other Soap	X	X
Non-Soap (Inorganic Thickeners)	X	X

*If two or more thickeners are used in a grease, it shall be listed under that grouping whose characteristics predominate.

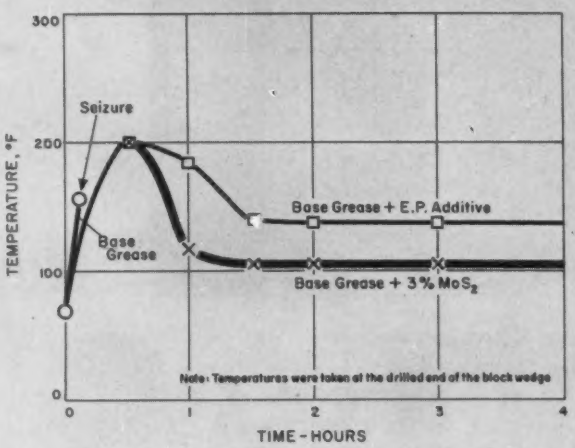
Most NLGI Active member firms are interested in the possibilities of a 1957 lubricating grease production survey and their company representatives have replied in the affirmative to a questionnaire released last month by the committee investigating the survey. An unofficial source estimated that companies representing more than 75% of the lubricating grease production in the United States have agreed to participate in this industry service.

With this vote of confidence from the manufacturers it is likely that definite action will be taken at the next meeting of the NLGI Board of Directors, in establishing procedures and practices.

Another service is in the making.


WEAR SCAR DIAMETER - MM
LOAD - KILOGRAMS
Mil-G-3278 Grease
Mean Hertz load value = 18
Mil-G-3278 - 5% Graphite
Mean Hertz load value = 26
Mil-G-7118 E.P. Grease
Mean Hertz load value = 34
Mil-G-3278 - 3% MoS2
Mean Hertz load value = 50

4-ball E.P. test shows the superior extreme pressure properties of MoS_2 grease over the same grease without additives. In the same test, grease containing 5% graphite had a mean Hertz load value of 26; the conventional E.P. grease Hertz value was 34.


TEMPERATURE, °F
TIME - HOURS
Seizure
Base Grease
Base Grease + E.P. Additive
Base Grease + 3% MoS2
Note: Temperatures were taken at the drilled end of the block wedge

Timken endurance test clearly shows how MoS_2 functions when added to a base grease. With base grease alone, the specimen seized in about 10 minutes. With MoS_2 added, lubrication was effectively sustained throughout the test at a reduced temperature of about 100°, compared with a temperature of about 130° for the conventional E.P. grease.

Moly-Sulfide additive extends effective lubrication

Laboratory and field tests prove that chassis lubricants containing MoS_2 sustain lubrication after base grease is wiped off

When standard chassis greases are first applied to shackle pins, ball points and other bearing points under trucks, trailers and passenger cars, excellent results are obtained. These greases, however, are subject to mechanical motion, such as reciprocation, pressure, oscillation and shock loading which tend to eject the lubricant.

At this point, chassis grease containing 3% Moly-Sulfide proves its great value. MoS_2 is forced between the rubbing surfaces, adheres to the metal and forms a protective film that prevents galling, welding and fretting. The extent to which MoS_2 sustains lubrication is demonstrated by substantial reduction in wear.

Four tests show how MoS_2 reduces wear

1. **Shell 4-ball extreme pressure test** (see illustration) —MoS_2 addition reduces wear more than 50%, increases load capacity about 70% over base grease.

2. **Falex 2-hour wear test**—As the chart here shows, MoS_2 sustains lubrication, as proved by a reduction in wear, by an average factor of 500.

Grease	Loss in weight of specimen
Lithium-base	1,000 mg.
Lithium-base plus 2% MoS_2	1.98 mg.—average of 3 runs

3. **Timken endurance test** (see illustration)—MoS_2 sustains lubrication well beyond the capabilities of the base grease alone, and at a lower temperature than conventional E.P. grease.

4. **Simulated shackle bolt service test**—oscillating friction machine—3% MoS_2 addition virtually doubles the effective lubrication of a lithium base chassis grease —is far more effective than conventional additions.

Hours to failure—average of 2 tests

Additive	None	3% MoS_2	5% ZnO	15% ZnO
Dry	350	564	336	555
Wet	162	264	109	85

On-the-road use proves MoS_2 prevents chassis wear

A St. Louis company reports no noticeable wear on chassis parts of auto transport trailers, since they selected an MoS_2 chassis grease.

Based on their own tests, several major automobile and truck manufacturers use—and recommend—MoS_2 grease for torsion suspension units, ball joint suspension, as well as for many other critical-wear areas.

Moly-Sulfide greases are available from many producers today. For a list of the manufacturers of these greases—which includes several major oil companies—and for a copy of "Molybdenum Disulfide as a Grease Additive," write to Department 58, *Climax Molybdenum Company, 500 Fifth Avenue, New York 36, N. Y.*

nlgi spokesman

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THE COVER

FAST gaining approval among users, the cartridge loaded grease gun is about to win another convert here, as this salesman demonstrates to the farmer the ease with which a motor for an irrigation pump can be serviced in the field. The history of this relatively new lubricating grease package is traced in this issue, in a feature authored by C. E. Gore, of Battenfeld Grease, entitled "The Grease Cartridge Story," beginning on page 24.

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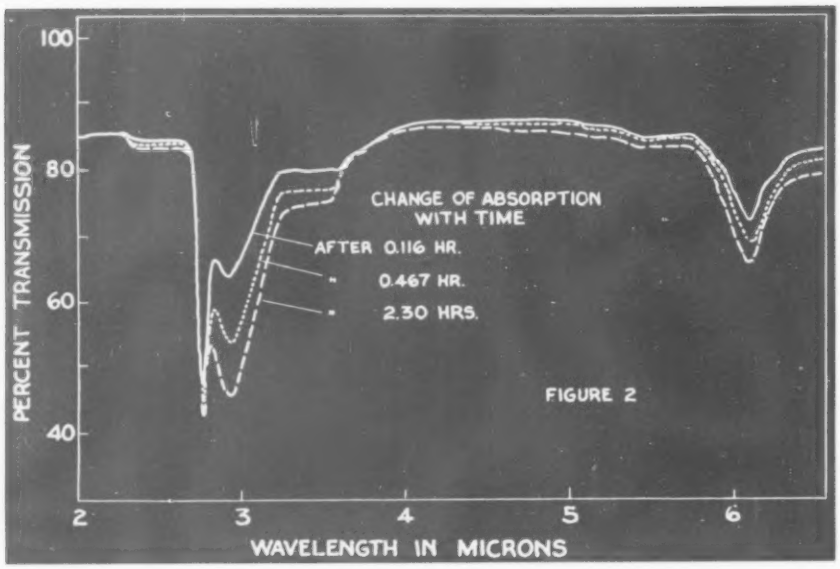

FIGURE 2

Infra

BENTONE GREASE

Determination of Water in Bentone Grease

INFRARED SPECTROSCOPY HAS been investigated by the authors for the past several years as a tool in grease structure studies.[1,2] Under a fellowship established by the Baroid corporation, this work has been directed specifically toward elucidating the mechanism of bentone grease gelation. In this regard infrared spectroscopy appears to be a novel and useful technique.

During the course of this work, it became necessary to determine the amount of water in a bentone grease. A method has been developed utilizing infrared spectroscopy.

The feasibility of an infrared analytical method for water in grease, was established as follows: A bentone grease was prepared by milling a 10 per cent Bentone 34-low gravity neutral oil slurry in a Tri-Homo mill. No polar gelling aid was employed; the nature of the oil resulted in good gelation. A small quantity of the grease was dried in a desiccator, and infrared spectra were obtained from both the original and the dried grease.

Three absorption peaks associated with water[3, 4, 5] were apparent in the spectrum of the original grease: at 2.76, 2.92, and 6.10 micons. In the spectrum of the dried grease, the peaks at 2.92 and at 6.10 microns were missing. The absorption at 2.76 microns, while reduced, was still present and is ascribed to "lattice" hydroxyl, which may be surface hydration associated either with the aluminum octahedra in the montmorillonite sheet, or may represent silanol groups.

To establish firmly the relationship of these peaks with water, a little water was added to a sample of the original grease, and a spectrum of this mixture was obtained. A decided increase in absorbance was noticeable in all three peaks, especially at 2.92 microns.

This evidence indicated that an analytical technique for determining water in grease was possible, and that the absorbance at 2.92 microns was probably the most suitable to use.

Apparatus

A model 21 Perkin Elmer double beam spectrometer was employed in this work. For handling grease-water mixtures, calcium fluoride cells were used to eliminate fogging difficulties which could arise with the use of sodium chloride.

Standard grease-water mixtures were blended in an

By E. C. MILBERGER, A. F. MILLER
Standard Oil Company (Ohio)

V. R. DAMERELL
Western Reserve University

A Contribution of the Chemistry Department, Western Reserve University

red Studies of

-WATER SYSTEMS

ASTM grease worker. This relatively simple technique for mixing small amounts of water with grease served quite adequately.

Consistency changes in the grease-water mixtures were observed by means of grease penetration measurements. Since the samples were too small for standard penetration measurements, the small cup and cone associated with the Shell roll test was used.[6]

The final step in the preparation of the initial grease was accomplished on a laboratory Tri-Homo colloid mill.

Procedure

The preparation of the initial grease followed the recommended procedures as specified by Baroid. This involved the addition of Bentone 34 to the oil while stirring with a Lightnin mixer. Stirring was continued as the mixture was heated to 190-210°F. By this time the oil-bentone mixture was thick, homogeneous, but still pourable. Several such preparations were combined. The finishing step consisted of one pass through a laboratory Tri-Homo mill set at clearance of approximately 0.002 inch, using gravity feed from the hopper. The result was a firm gel. The concentration of Bentone 34 in this grease was 10 per cent by weight.

Typical properties of the oil used, designated as 100 zero pale, are shown in Table I.

TABLE I

Zero Pale 100 Oil

Gravity	21-23
Pour °F max.	-40
Flash °F min.	310
Color ASTM MAX.	2
Visc. SSU @ 100	100-115

With the grease described above as the "master" batch, and herein referred to as the original grease, a number of known grease-water samples were prepared. The infrared spectra from these mixtures were analyzed to establish a calibration curve. However, there were difficulties arising from features involving the nature of the bentone grease-water system.

The first plan entailed dehydrating the master batch of grease so that the concentration of water in the grease-water mixtures could be calculated easily. This attempt was made by placing the original grease in a

desiccator improvised from a five gallon bucket filled to a depth of 5-6 inches with drierite. Since this work was conducted in mid-winter, the relative humidity was consistently under thirty per cent, and this arrangement worked well for drying thin grease films.

However, even though the grease was stirred daily to expose fresh surfaces, the extent of drying achieved was found to vary with depth in the can. This nonuniformity in the water content of the original grease invalidated the calculated percentages of water added.

In a second attempt, the master batch of grease was stored in a tightly closed can. From spectra of this grease, obtained at intervals, a standard absorbance was obtained for each of the absorption peaks. The grease-water mixtures prepared were then considered as original grease plus some known additional quantity of water. Later, by plotting the difference in the corresponding absorbances between these samples and the original grease, a value was obtained for concentration of water in the original grease.

This method appeared to work very well. The procedure involved preparing the standard grease-water mixture in the ASTM grease worker, obtaining the Shell penetration, and then running the infrared spectra. This very precise work schedule, however, very nearly obscured an interesting phenomenon, which was subsequently found to invalidate all of the data.

Toward the close of this second endeavor, one of the grease-water mixtures was rechecked for penetration. The check value was considerably lower. Additional measurements over a period of an hour continued to indicate an increase in consistency. The infrared spectra was also repeated after this time lapse. The absorption peaks under study had all increased substantially.

This time factor was studied by obtaining spectra of a freshly prepared sample at frequent intervals. Absorbance values changed only slowly after two hours, hence this time of standing was specified for all grease-water mixtures investigated.

A third procedure was then adopted. The grease worker was carefully cleaned with carbon tetrachloride and dried. 150 grams of grease was weighed into the worker cup and roughly leveled by jarring the cup on a padded bench top. The desired quantity of water was added from a graduated pipet. (The weight of water was taken to be equivalent to the volume.) The grease worker was assembled and the mixture worked for 120 double strokes. The grease was stored in a seamless steel ointment can for a minimum of two hours. (For further protection against loss of water, the lid was sealed with plastic electrician's tape.) After this time lapse, the grease was returned to the worker cup, worked sixty strokes and a Shell penetration was obtained. An infrared spectrum of this final worked grease was then recorded.

Generally, samples were prepared in the sequence of increasing concentration of water. Between preparations, the grease worker was cleaned by wiping the cup, and the perforations in the plate were cleaned with the aid of pipe cleaners.

The infrared technique employed was as follows:

Sufficient grease was placed between the calcium fluoride sample plates such that when the demountable cell was assembled, the sample was evenly distributed in the cutout portion of the 0.1 mm lead gasket. Precautions were taken that none of the grease squeezed past the gasket, since this would increase cell thickness.

The above cell was placed in the sample beam of the infrared spectrometer. The cell in the reference beam was a 0.1 mm fixed cell containing the oil used to prepare the master batch of grease. In this manner, the spectrum obtained was largely that of the Bentone 34 gelling agent alone, or of the gelling agent plus additional water absorbed or associated in some manner. This technique eliminated to a large extent interfering hydrocarbon bands at approximately 3.4 and at 6.2 microns, which in the latter case would almost completely overshadow the water absorption at 6.10 microns.

Absorbance measurements were determined by the base-line technique. A single baseline was drawn from 2.67 to 4.0 microns for both the 2.76 and the 2.92 micron peaks, and from 5.7 to 6.5 microns for the peak at 6.10 microns. These locations were wide enough to avoid minor changes in background in the immediate vicinity of the measured absorptions.

Experimental Results

To determine the effect of time on the magnitude

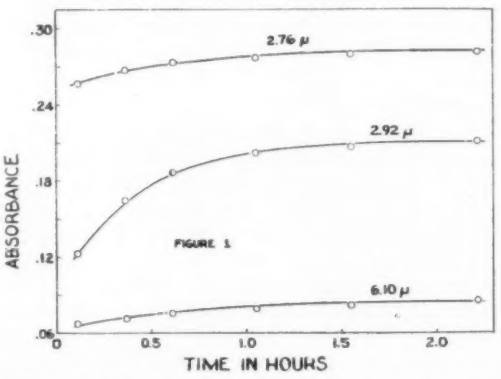

FIGURE 1 is a plot of absorbance with time. There was no possibility of composition changes due to water loss.

of absorption of each of the water peaks, a water-in-grease sample was prepared as described with 0.5 weight per cent of added water. Figure 1 is a plot of absorbance with time. The same sample mount was used for each spectra, so that there was no possibility of composition changes due to loss of water. It was observed that absorbance changed only slowly after two hours.

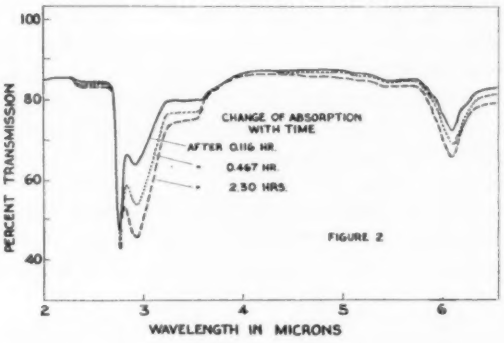

FIGURE 2 shows increasing absorption at each water peak.

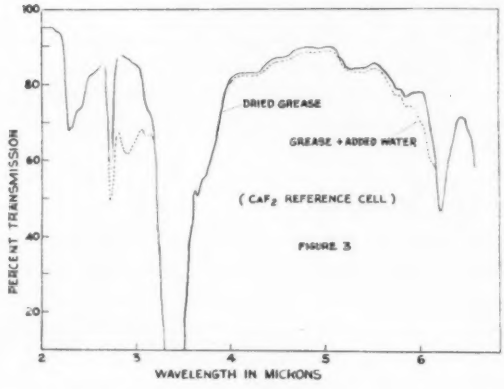

FIGURE 3 Hydrocarbon absorption at 6.2 microns (phenyl) largely obscures the water absorption at 6.10 microns.

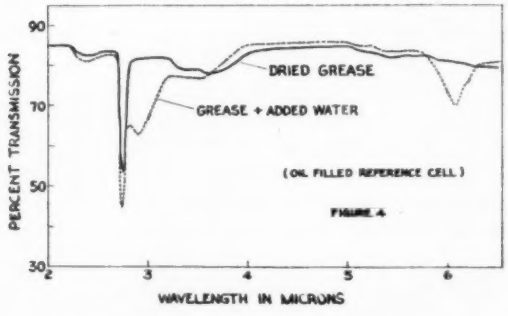

FIGURE 4 Each of the water absorption peaks is clearly defined in the spectra when the oil-filled cell is used.

The first point on each of the curves, corresponding to approximately ten minutes, is representative of the type of measurements obtained before this phenomenon was discovered. Figure 2 shows the increasing absorption at each water peak with time. These are direct traces from the original instrument record chart.

The use of a calcium fluoride reference cell and the oil-filled reference cell is illustrated in Figures 3 and 4 respectively. Spectra for both a well-dried grease as well as for a water-in-grease sample are shown in both plots. As is evident in Figure 3, the hydrocarbon absorption at 6.2 microns (phenyl) largely obscures the water absorption at 6.10 microns. The spectra of the dried grease in Figure 3 clearly shows the complete disappearance of the 2.92 micron absorption. Each of the water absorption peaks is clearly defined in the spectra when the oil-filled reference cell is used, as shown in Figure 4.

Only the data obtained after two hours standing are listed in Table II. The absorbances shown are as meas-

TABLE II

Absorbances and Penetration

Sample	Wt. % H_2O Added	ABSORBANCES 2.76μ	2.92μ	6.10μ	Shell Penetration
1	None[1]	0.232	0.044	0.032	136
2	0.10	0.235	0.069	0.044	118
3	0.17	0.252	0.110	0.059	109
4	0.27	0.260	0.145	0.064	108
5	0.50	0.272	0.208	0.079	109
6	0.66	0.292	0.273	0.093	109.5
7	1.00	0.331	0.387	0.120	108.5
8	1.44	0.402	0.537	0.169	107.5
9	1.96	0.414	0.620	0.188	109
10	...[2]	0.200	0.008	0.002	...
11	0.56[3]	0.288	0.176	0.079	

1. Original grease.
2. Original grease after 3 days drying.
3. Added to original grease dried for 3 days.

TABLE III

"Corrected"[1] Absorbances

Sample	2.76μ	2.92μ	6.10μ
2	0.003	0.021	0.012
3	0.020	0.066	0.027
4	0.028	0.101	0.032
5	0.040	0.164	0.047
6	0.060	0.229	0.061
7	0.099	0.343	0.088
8	0.170	0.493	0.137
9	0.182	0.576	0.156

1. Actual absorbance of sample—absorbance of original grease (sample No. 1) at corresponding wave length.

ured, and sample composition is designated as weight per cent water added. By subtracting the absorbance of the original grease at each of the water peaks from the corresponding absorbances of each of the grease-water mixtures, the "corrected" absorbances listed in Table III were obtained.

A plot of "corrected" absorbance versus weight per cent water added is shown in Figure 5. The measured absorbance of the original grease at 2.92 microns is indicated by the horizontal dotted line. The intersection of this line with the 2.92 micron curve corresponded to a value of 0.14 per cent water in the original grease. Assuming no loss of water during the preparation of the grease, and perfectly dry oil, this corresponds to a water content of 1.4 per cent in the original Bentone 34. This seems reasonable.

A further point of interest in Figure 5 is the near identity of the corrected absorbances for the water absorption peaks at 2.76 and 6.10 microns. This indicates

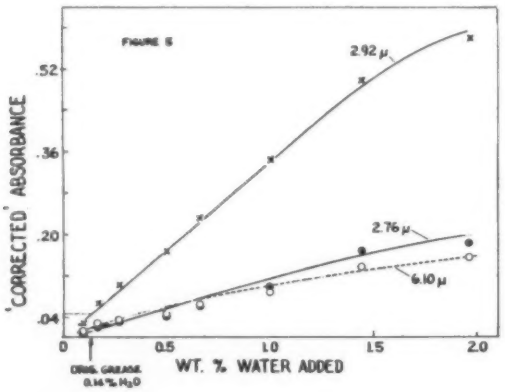

FIGURE 5 Plot of "corrected" absorbance versus weight per cent water added is shown. Measured absorbance of original grease at 2.92 microns is the dotted line.

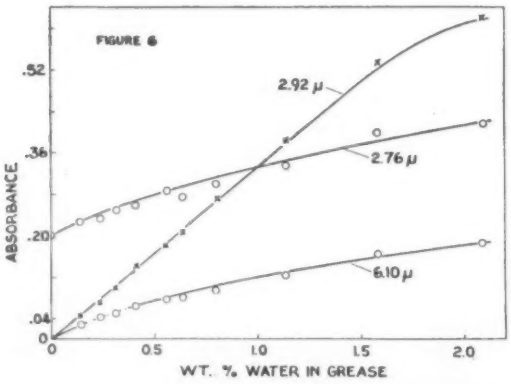

FIGURE 6 The final calibration curve is illustrated.

that the increase at 2.76 microns is due to incremental absorption of the added water onto the inherent "free" hydroxyl absorption of the Bentone gelling agent.

The final calibration curve, Figure 6, was drawn by plotting the actual absorbances listed in Table II versus the actual water content of each of the samples. This latter value is the per cent water added plus the per cent water in the original grease—0.14 per cent. The absorbances obtained for the original grease are the points shown at 0.14 per cent water.

The curve corresponding to 2.76 microns intersects the vertical axis at 0.200, which is the value found for the absorbance at 2.76 microns in the spectrum of a well-dried grease. As shown in Table II, the absorbance calculated for the absorptions at 2.92 and 6.10 microns in the spectrum of this dried grease are nearly zero. Consequently, the corresponding curves in Figure 6 pass through the origin.

To check out this calibration, a water-grease mixture was prepared by adding a known weight of water to the well-dried grease. The results are listed in Table II, and are plotted in Figure 6. The points fall on the respective curves very satisfactorily.

The linear response of the 2.92 micron absorbance with increasing water content, up to two weight per cent, indicates that measurement of absorbance at this wave length is satisfactory for the determination of water in bentone grease.

Additional Observations

The effect of water on the physical properties of bentone grease is quite marked. Figure 7 illustrates the changes in consistency with varying water content. A small additional quantity of water added to the original grease resulted in a marked increase in consistency as revealed by lower penetration values. However, above approximately 0.3 per cent water, no further change in penetration was noted.

The well-dried bentone grease was too soft for a penetration measurement. This indicates that small quantities of water are essential for grease formation. This factor is under current investigation.

An interesting side light may be cited with reference to the data in Table IV. The sample labeled unhomogenized mixture refers to the Bentone 34-oil mixture prior to the Tri-Homo finishing step. This material was a homogeneous, viscous liquid with little or no gel properties. The absorbances at 2.92 and at 6.10 microns are very similar for the unmilled and for the milled original grease, but a distinct change in absorbance at 2.76 microns is evident.

The agreements in absorbance at 2.92 and 6.10 microns respectively indicates that the water content of

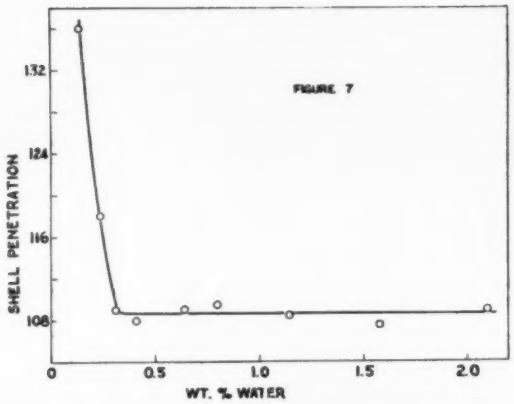

FIGURE 7 Changes in consistency—effect of water on physical properties of bentone grease is quite marked.

TABLE IV

Sample	2.76μ	2.92μ	6.10μ	*Shell Penetration*
Unmilled original grease slurry	0.187	0.025	0.016	Too soft
Milled original grease	0.232	0.044	0.032	136

the Bentone 34-oil mixture did not change as a result of the milling treatment.

The increase in absorbance at 2.76 microns for the milled grease is proposed to reflect the increased dispersion brought about by milling. Greater dispersion would expose more bentone surface and hence more of the inherent "lattice" hydroxyl or surface hydration of the bentone particle.

Further speculation along this line, although interesting is beyond the scope of this presentation, and will be reserved for future publications.

Bibliography

1. V. R. Damerell, and E. C. Milberger, Nature, 178, 200 July 28, 1956.
2. V. R. Damerell, and E. C. Milberger, "On the Mechanism of Gelation of Bentone Grease" presented to Meeting-in-miniature, Cleveland Section, Amer. Chem. Soc. Dec. 19, 1956.
3. Herzberg, G. "Infrared and Raman Spectra of Polyatomic Molecules," D. Van Nostrand Co., Inc. 1945 p. 280.
4. Randall, H. M., R. G. Fowler, N. Fuson, and J. R. Dangl "Infrared Determination of Organic Structures," D. Van Nostrand Co., Inc. 1949 p. 46.
5. Lucchesi, P. J. and W. A. Glasson, Journal of the American Chemical Society Vol. 78, 1347, 1956.
6. McFarlane, R. P. Inst. Spokesman 6, No. 12 (1943).

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TOP INVENTOR in Esso Research and Engineering company, Arnold J. Morway, left, shows vice president Willard Asbury a test used in developing new way of manufacturing an industrial grease. Chemist Morway received his 150th U. S. patent recently for inventing the process. He has more patents than any other employee of the company (see page 36), scientific affiliate of Standard Oil company (New Jersey). Cylinder he is holding contains grease to be homogenized in this device at Linden, N. J. laboratories.

PROLIFIC INVENTOR PROCURES HIS 150th U. S. PATENT

AN ESSO RESEARCH and Engineering company chemist—who was instrumental in developing the "Eisenhower Grease" used in World War II Normandy Beach landings—has received his 150th U.S. patent.

The inventor, Arnold J. Morway, 50, of 19 Acken Drive, Clark, New Jersey, was issued the patent May 1, 1957 and became the first Esso Research employee to hold that many inventions. His patent, No. 2,790,-769, covers an improved method of manufacturing a widely-used, high temperature grease for anti-friction bearings. The invention permits the use of a broader variety of raw materials and allows the grease to be made more economically.

At a recent meeting of oil scientists from around the world, Mr. Morway was saluted by his colleagues for the achievement. Esso Research vice-president Willard C. Asbury presented him with a gift – a movie camera—and congratulated him for his "unequalled inventiveness" and contributions to "many major advances in the field of lubrication."

Mr. Morway was also the first employee of Esso Research, scientific affiliate of Standard Oil company (New Jersey), to obtain 100 patents.

The "Eisenhower Grease" was a formula especially devised to protect automotive equipment during the World War II Normandy Beach landings.

Joining the company in 1929 after receiving a chemical engineering degree from the University of Florida, he has been in research work ever since, and received his first patent in 1939. He did graduate work at Columbia University and Brooklyn Polytechnic Institute. "Red" Morway has recently been appointed a research associate with his company in recognition that his services as a technical man are of as much value as are similar positions in administrative field.

He was born in Sommerville, Mass., but spent most of his youth in Florida. He played high school football both in Orlando and at Duval High in Jacksonville. Mr. Morway, an avid sport fan, especially interested in hockey, football and baseball, is also a gardening enthusiast whose peonies and daffodils have won civic club awards.

Mr. and Mrs. Morway have two daughters, one who attends the University of Georgia, at Athens, and the other the Vail-Deane School in Elizabeth, New Jeresy.

A Method for the Prediction of Hardness Changes of GREASES IN STORAGE

SUMMARY

A knowledge of the changes in hardness which greases undergo in storage is of importance to the producers and consumers of greases for several reasons. Since the actual determination of hardness changes during storage requires up to two years time, the need of an accelerated test is apparent. After preliminary trials of possible methods, a test involving the ASTM oxidation bomb was evolved. An investigation of test variables included type of gas, pressure, temperature, and presence of moisture. The set of conditions finally selected was based on tests on products of different age-hardening tendencies. The method was proof-tested on additional greases of varying storage-hardening tendencies. One day in the accelerated storage test is equivalent to approximately 2.4 months in normal storage for hardness changes on an unworked basis.

By G. W. ECKERT, The Texas Company

Presented at the National Lubricating Grease Institute Annual Meeting, Chicago

THE PURPOSE OF this discussion is to describe a relatively short-time test procedure for the prediction of the age-hardness changes of greases. A knowledge of the changes in hardness that greases undergo during periods in which the materials are not being worked is of importance to producers and to consumers of greases. It is common knowledge in the industry that variations of hardness with time can take place not only in storage containers but also in pumping equipment, centralized lubrication systems, and in bearings. The rates of hardness changes differ considerably with the many grease formulations.

Information on some age-hardening tendencies of greases has been recorded in the literature. Boner[1] reported the results of penetration measurements made at intervals after shearing had ceased. McLennan and Smith[7] published results of penetration tests on various greases as a function of time. Stokeley and MacDonald[8] determined the rates of hardening of greases stored at 120°F. Hotten and Farrington[2] made a series of penetrations to follow hardness changes with time on previously worked samples. The penetrations in this latter work were made with a half-scale cone described by Hotten and Kibler[3]. The change of consistency after standing can be determined with a viscometer as suggested by Marusov.[5]

Normal Storage Behavior of Greases Used in Preliminary Work

To establish the types of hardness-time curves that an accelerated test might be required to indicate or

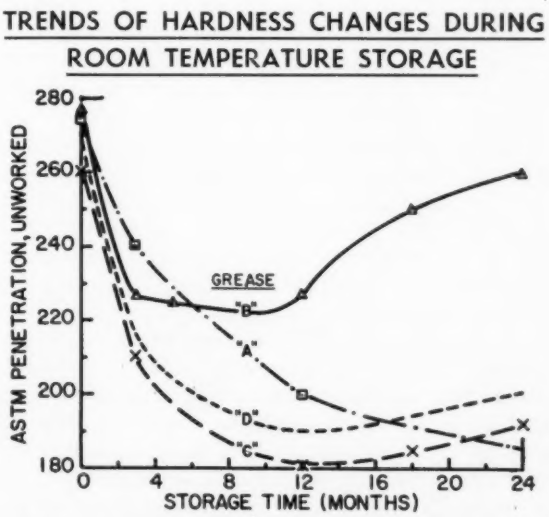

FIGURE 1. Curves resulting from two year storage tests of four types of greases. Grease A hardened progressively.

predict, two-year storage tests at room temperature were made on four types of greases (sodium base grease, two calcium base greases of different formulations, and a sodium:calcium soap grease). The greases were stored at room temperature using five-pound containers. The types of time-hardness curves obtained with these greases are shown in Figure 1. Unworked penetrations are shown and were obtained on the samples in the storage containers. Grease A showed a progressive hardening throughout the storage period, but Greases B, C, and D exhibited hardening followed by softening.

Selection of Test Conditions for the Accelerated Age-Hardness Test

Two types of evaluations were considered to be potentially useful for the purpose of accelerating the hardness changes which greases exhibit with time at room temperatures. These were (a) an oven test in which the hardness changes are accelerated by an elevated temperature and (b) bomb tests in which the hardness changes are accelerated by both elevated temperature and pressure. Neither of these techniques is novel with this work. Oven types of tests at various temperatures have been used by others. The well-known oxidation test, involving the ASTM Oxidation Bomb, was originally designed for predicting storage stability of greases in machine parts.[3] In this bomb method, the relative behavior of greases was measured by pressure drop and did not involve a determination of consistency change.

For the selection of the type of test equipment for use, oven tests and ASTM Oxidation Bomb type of tests were made at 175°F. In the oven method, one-pound samples were tested at intervals by means of the ASTM penetrometer. In the ASTM Bomb tests (using oxygen at 110 p.s.i. pressure) the greases were placed in two ounce cans instead of the usual oxidation test dishes. The samples from the bombs were examined for hardness changes by a micro penetrometer (described by Kaufman, Finn, and Harrington[4]) and by ring penetrations. The ring penetrator was used to obtain penetrations on undisturbed samples and also on small quantities of greases. After trials of various sizes of rings, the one finally selected was 0.5 inch in diameter (i.d.) and was made from 0.048 inch diameter piano wire. The construction of the ring is indicated in Figure 2. The ring penetrator was used in the ASTM penetrometer and was counterbalanced so that the actual falling weight on the grease could be changed between tests to obtain depth of penetration versus falling weight curves. ASTM penetrations can be estimated from the ring penetrations knowing the applied weight used with the ring penetrator. The conversion factors are not reported herein, but Figure

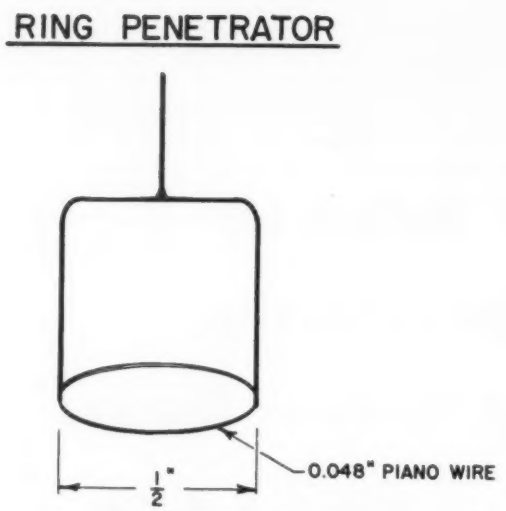

FIG. 2. Ring penetrator was used on undisturbed samples.

3 illustrates that a family of curves is obtained by plotting ring penetration against applied weight for various types of greases of varying hardness. The relative positions of the individual curves vary with the ASTM penetrations.

A comparison of the results of the oven and the bomb tests showed that the time required in the oven test to obtain the same amount of hardening observed in the bomb test in 3 days was one month for one grease and three months for another grease. The shorter time required for the bomb test to give a specific hardness change made this method the more attractive. Thus, the application of pressure as well as an elevated temperature proved to be more favorable than using

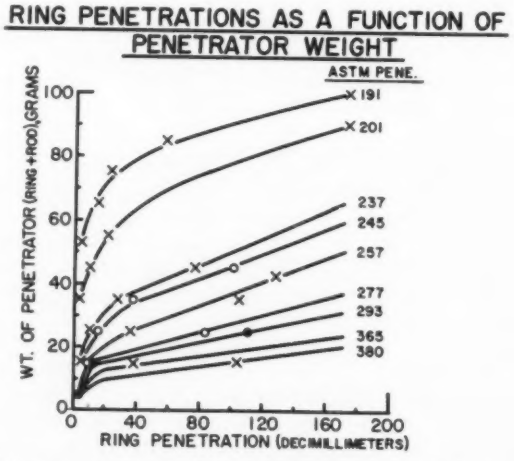

FIGURE 3. Illustrates that a family of curves is obtained by plotting the ring penetration against applied weight.

only an elevated temperature for an accelerated storage test. There remained to be established, however, the specific conditions of temperature, pressure, and type of gas to use.

For selection of the test temperature, runs were made at 132, 150, and 168°F. for 2, 4, 6, and 8 days on two greases using oxygen at 110 p.s.i. pressure. Hardness-time curves are given in Figure 4 for Grease B. This material in normal storage gives a hardening-softening change. The 132°F. test on Grease B did not show up the softening stage in the 8 day period, whereas the 168°F. test appeared to give a greater degree of hardening and softening than was obtained in normal storage. The results of the 150°F. tests appeared to show the greatest similarity to the data obtained in normal storage. The curves for Grease A are given in Figure 5. The tests at 150°F. and 168°F. appeared to give results comparable to those of normal storage. The 150°F. temperature was selected, mostly on the basis of the tests on Grease B.

Bomb tests at 150°F. were made on Grease A and Grease B with oxygen at pressures of 30, 70, 110, and 150 p.s.i. for selection of the pressure condition. Curves for these greases are given in Figures 6 and 7, respectively. On the basis of these results, either 110 p.s.i. or 150 p.s.i. appeared to show trends resembling the hardness-time curves obtained in normal storage. Since the 110 p.s.i. pressure is standard for the ASTM Oxidation test for grease and is used in a routine manner, the 110 p.s.i. pressure was selected over the 150 p.s.i. pressure.

The effects on accelerated age-hardening obtained by using oxygen, nitrogen, and carbon dioxide, respectively, were investigated. Runs were made with the dry gases and also with 5 ml. of water added to bombs in runs with these gases. The pressure was 110 p.s.i. and the temperature was 150°F. in all cases. Time-hardness curves for Grease A are given in Figure 8. The grease showed no thermal hardening as evidenced by the test using dry nitrogen, but the grease hardened in the dry oxygen and also in the dry carbon dioxide. The presence of moisture induced hardening.

Age-hardness curves for Grease D obtained with the different gases are shown in Figure 9. Effects of the

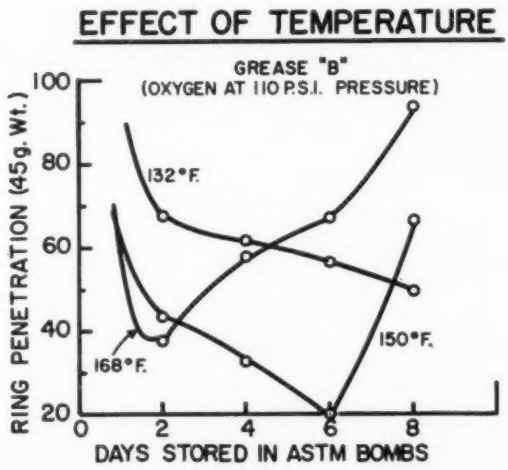

FIGURE 4. Hardness time curves are given for grease B.

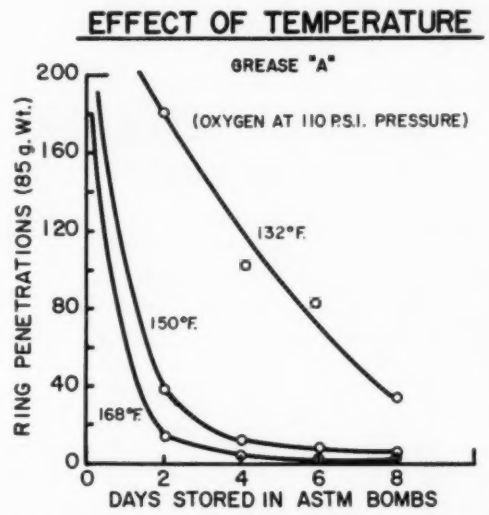

FIGURE 5. Tests for grease A at 150°F and 168°F appear to give results comparable to those of normal storage.

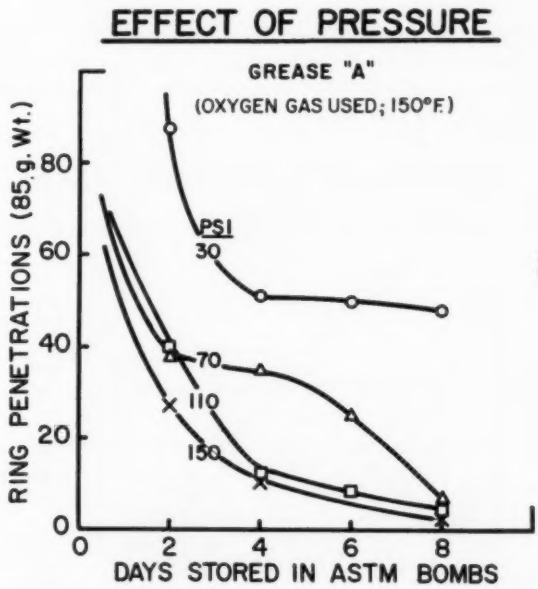

FIGURE 6. Bomb tests at 150°F were made on grease A.

gases on the hardness changes with this grease were much different from those shown by Grease A. With Grease D, the hardness changes using dry oxygen and dry carbon dioxide were about the same as that observed in the test using dry nitrogen. Moisture in the gases caused the grease to be softer than in the absence of the water.

On the basis of the results with the different gases, the effects which can alter the hardness of a grease in the accelerated storage test are:

1. Thermal effects (as evidenced by tests using nitrogen gas)
2. Oxidation
3. Carbonation
4. Hydrolysis or Hydration

Runs were also made with air (dry and moist) and with several combinations of nitrogen and oxygen for comparison with runs made with oxygen. Curves for the mixed gases are not presented here, but dry air showed more nearly the same trends observed in normal storage. There was not much difference between the effects shown by dry oxygen and by dry air, but a slightly better correlation with normal storage appeared to be shown with the dry air. For this reason, dry air was selected over dry oxygen. Comparative curves for dry oxygen and dry air are not shown, because of the similarity of the results. Curves for dry oxygen are given in Figures 6 to 9, inclusive.

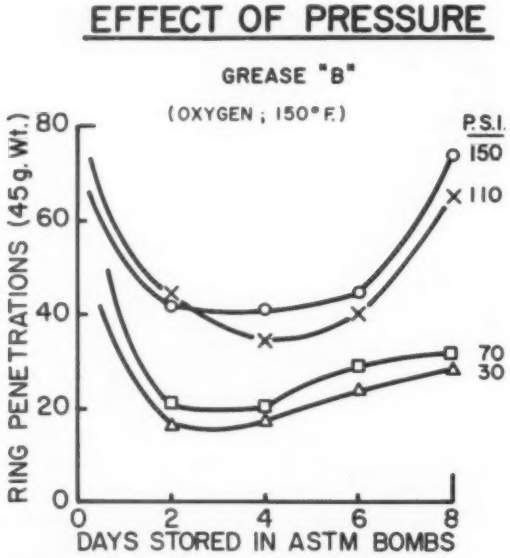

FIGURE 7. Grease B with oxygen at pressures of 30, 70, 110 and 150 p.s.i. for selection of pressure condition.

Penetration Changes of Greases in the Accelerated Storage Test

Having obtained promising results with the four greases in the preliminary work, a comparison was then made of the accelerated storage and the normal storage behavior of other widely different types of greases. Greases selected for this purpose included lithium soap products, calcium soap greases, sodium-calcium soap greases, and solid thickened material.

For this work, it was decided to obtain penetrations by means of the reduced-scale cones described by Hotten and Kibler.[3] These reduced-scale (basis ASTM) cones appeared to be better suited for routine testing than the ring penetrator. Preliminary trial indicated that penerations obtained with these cones were critical to the size of the grease container which was important in this work, since two-ounce cans were used for storage rather than reduced-scale ASTM cups. For samples of greases in two-ounce deep-form cans, the equation developed for the half-scale cone was:

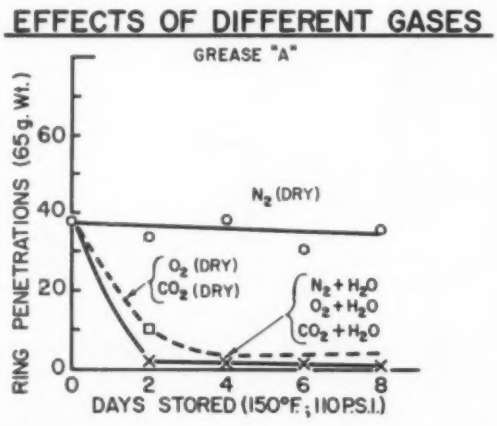

FIGURE 8. Time-hardness curves for grease A are given.

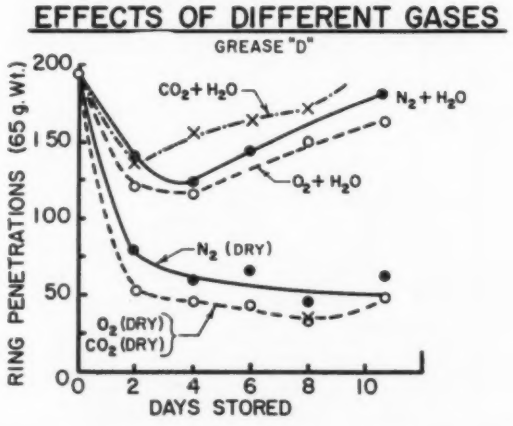

FIGURE 9. Age-hardness curves for grease D with gases.

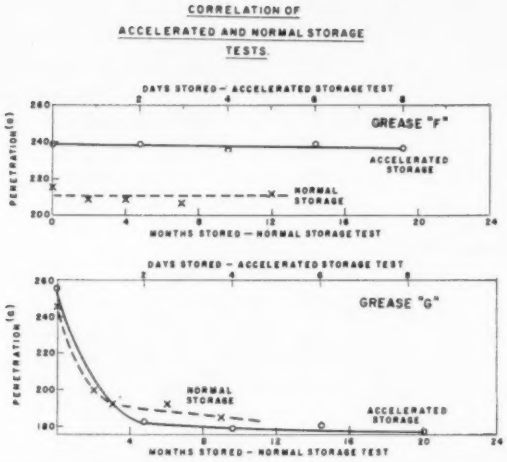

FIGURE 10. Correlation of accelerated and normal storage.

$$P = 1.47\ p + 61.7$$

where P = ASTM penetration and p = half-scale cone penetration.

Comparative storage results on an unworked basis were obtained using the accelerated and normal storage test conditions. In the accelerated test, unworked penetrations were obtained with the half-scale cone after 2, 4, 6, and 8 days storage in the bombs. In the normal storage tests, samples in one-pound cans were punched with the full-scale ASTM cone at intervals up to a total storage time of one year. Six of the greases were made in duplicate batches, each of which were tested in the accelerated and normal storage tests. Results on duplicate batches were in good agreement. Typical curves for individual batches showing comparisons of the results of the accelerated and normal storage tests are given in Figure 10 and 11. With each grease, the curve for the accelerated storage shows the same trend as that for the curve for the

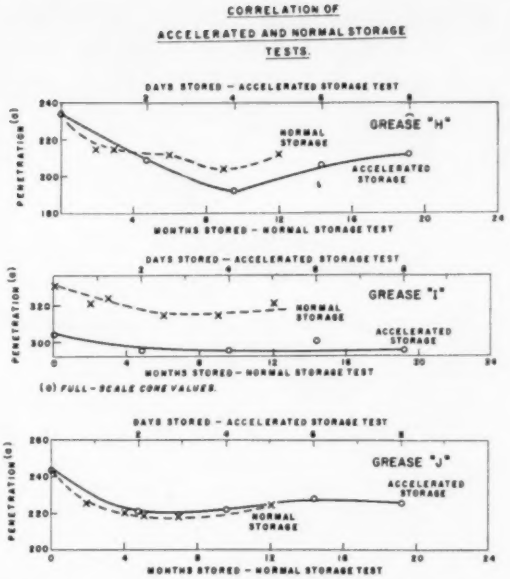

FIGURE 11. Typical curves for individual batches tested.

normal storage. Where the curves do not coincide (such as for Grease F or Grease I) no explanation has been verified. On the basis of the data obtained in this work, one day in the accelerated storage test is equivalent to approximately 2.4 months in normal storage. The abscissa for the graphs in Figure 10 and 11 were made so that 1 day for accelerated storage has the same interval as 2.4 months for the normal storage. The curves indicate that this relation is a good approximation for the two tests and for all the greases examined.

In order to follow changes in penetration on a worked basis, a third-scale worker was constructed as shown in Figure 12. Perforated plates with different quantities and sizes of holes were tried before arriving at a satisfactory plate (6 holes of 3/16 inch diam-

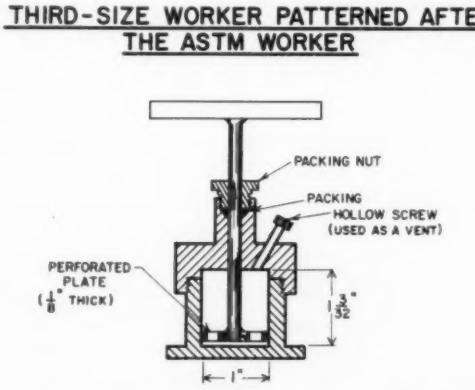

FIGURE 12. Third-scale worker for penetration changes.

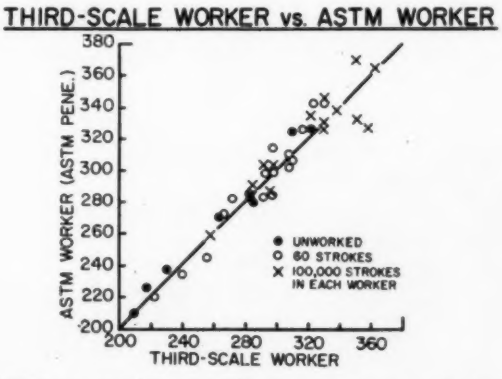

FIGURE 13. Third-scale worker gave changes equivalent to those with 60 and 100,000 strokes in the ASTM worker.

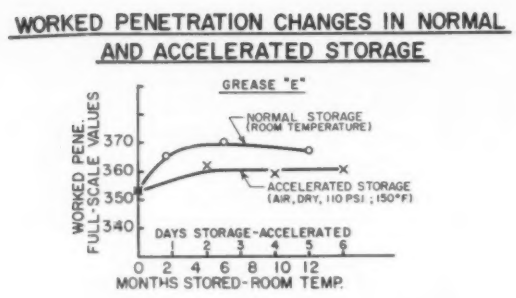

FIGURE 14. Good agreement was obtained in that a very slight softening on a worked basis occurred in both tests.

eter). Samples after working were transferred to a quarter-scale (basis ASTM) cup and punched with a quarter-scale (basis ASTM) cone. With this third-scale worker, 60 strokes and 100,000 strokes gave changes in penetrations converted from quarter-scale cone values which were equivalent to those obtained with 60 and 100,000 strokes, respectively, in the ASTM worker, as shown by Figure 13. With one grease of interest, a comparison was made of the change of worked penetration in accelerated storage with the change in normal storage. As Figure 14 shows, good agreement was obtained in that a very slight softening on a worked basis occurred in both tests.

Final Procedure for Accelerated Storage Test

The freshly prepared grease is placed in two-ounce deep-form seamless cans (1⅞ inches wide by 1¼ inches deep). Two of these filled cans are put into each ASTM Oxidation Bomb. The current practice is to set the lower can directly on the bottom of the bomb. The upper can is separated approximately one-half inch from the lower can by means of a spacer. This spacer rod can be bent into the shape of a triangle so that the upper can is supported evenly and also that the gas in the bomb has access to the grease in the lower can. The bombs are pressurized to 110 p.s.i. with air dried by being passed through Drierite from a compressor. The bombs are stored at 150°F. and withdrawn from the constant temperature bath at 2, 4, 6, and 8 day intervals. Two bombs are taken out at each time period. Half-scale cone penetrations at 77°F. are made on the samples in the cans from each bomb. If the worked penetration is desired, the samples after the 2, 4, 6, and 8 day periods can be worked in the third-scale worker. Penetrations on the worked samples are obtained at 77°F. by means of the quarter-scale cone.

Conclusions

An accelerated storage procedure has been developed for predicting the hardness changes of greases during normal storage. One day in the accelerated storage test is equivalent to approximately 2.4 months in the normal storage test for hardness changes on an unworked basis.

Literature Cited

1. Boner, C. J., "Thixotropic Qualities of Soap-Hydrocarbon Systems," J. Physical & Colloid Chemistry, Vol. 52, page 1383 (1948).
2. Hotten, B. W., and Farrington, B. B., "Thixotropy of Lubricating Greases," ASTM Bulletin, No. 189, page 53 (1953). (A report of ASTM Technical Committee G-IV work).
3. Hotten, B. W., and Kibler, G.M., "Improved Miniature Penetrometer Cones for Determination of Lubricating Grease Consistency," Anal. Chem., Vol. 22, page 1574 (1950).
4. Kaufman, G., Finn, W. J., and Harrington, R. J., "Miniature Penetrometer for Determining Consistency of Lubricating Greases," Ind. and Eng. Chem., Anal. Ed., Vol. 2, page 108 (1939).
5. Leet, R. H., "Thickener Particle Dimensions and Lubricating Consistency Grease," NLGI Spokesman, Vol. 19, No. 1, April, 1955, page 20.
6. Marusov, N., "Flow Properties of Lubricating Greases," The Institute Spokesman, Vol. 15, No. 5, August, 1951, page 8.
7. McLennan, L. W., and Smith, G. H., "The Thixotropic Characteristics of Lubricating Oil Greases," ASTM Bulletin, No. 152, page 71 (1948).
8. Stokeley, J. M., and MacDonald, R. M., "Grease Characteristics that Significantly Affect Dispensers," NLGI Spokesman, Vol. 17, No. 10, January, 1954, page 24.
9. Wright, F. L., and Lutz, W. A., "Determining Quickly the Storage Stability of Lubricating Greases," Product Engineering, June, 1936, pages 210-213.

About the Author

GEORGE W. ECKERT *is a project leader in grease research for the Texas company. His undergraduate work was completed at the University of Illinois with a B. S. in chemical engineering. He then entered Missouri school of Mines and Metallurgy and received an M. S. degree in chemistry, followed by a Ph. D. from the University of Missouri. Eckert has been with the Texas company for seventeen years.*

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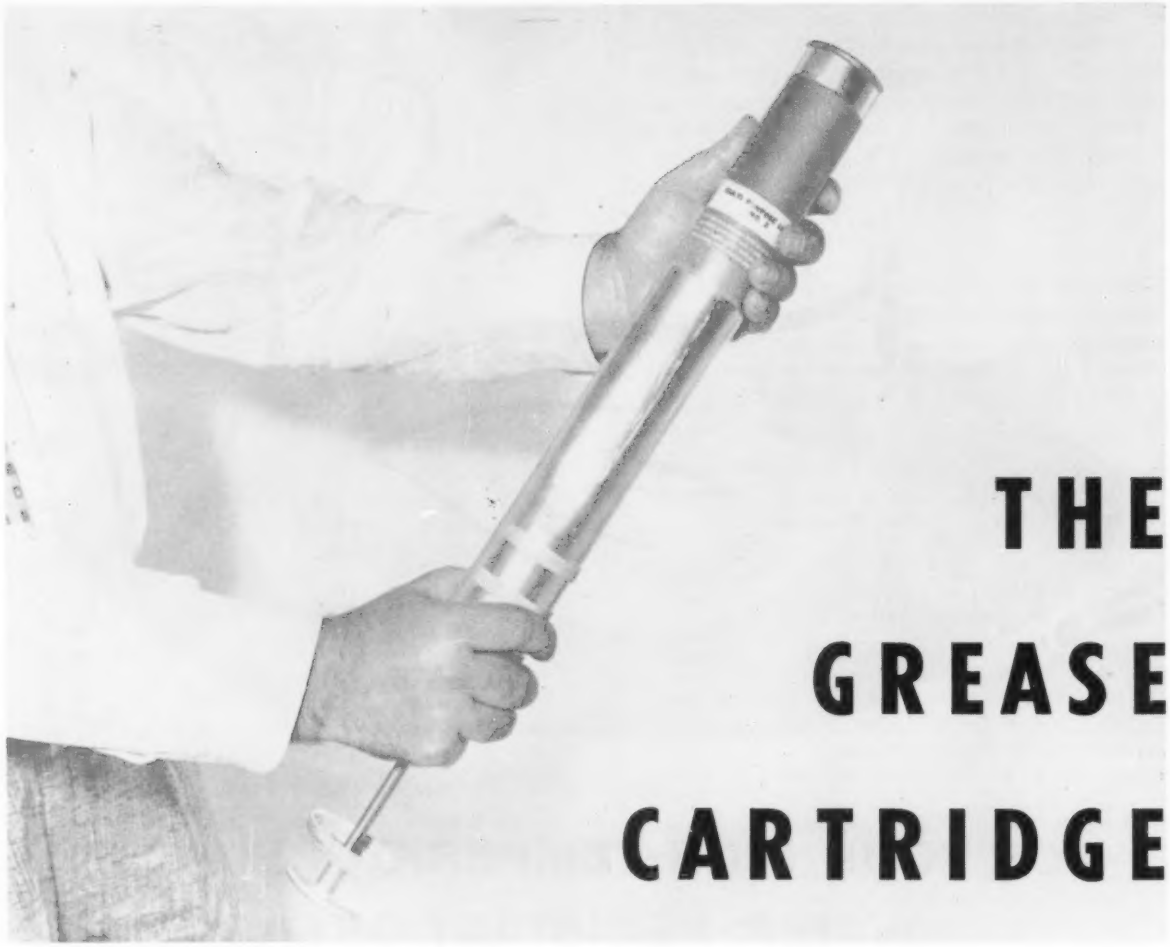

THE GREASE CARTRIDGE

By C. E. Gore, **Battenfeld Grease and Oil Corporation**

A FRESH, NEW APPROACH to grease packaging and dispensing has made itself felt in the national lubricants marketing picture. From a quiet beginning scarcely two years ago, and from a history of failure in the past, the fourteen and one-half ounce lubricating grease cartridge and companion cartridge loading grease gun have pushed their way into the forefront of modern merchandising methods.

The public, ever ready to accept new and more convenient methods of doing things, has pushed the sales of grease cartridges from less than 1,000,000 in 1955 to an estimated twenty-five million and more in 1957. Marketwise, sales and promotion executives believe this is only the beginning and forecast the reaching of a hundred million cartridge sales in the forseeable future.

Some feel the grease cartridge will eventually replace most of the 35-pound lug and smaller size packages. This eventuality becomes more and more probable as the price of steel continues to increase. Even today, the cartridge container cost is quite competitive when measured against smaller size steel containers.

Why has the new package caught on so spectacularly? There are a number of answers. The most obvious being the ease of handling for the consumer. To put a fresh grease supply in a cartridge loading grease gun requires only about twenty seconds of clean, "mess-

WHY MONKEY AROUND WITH "TYING-UP" VALUABLE TIME AND MONEY IN VEXING LUBRICATION PROBLEMS?

Battenfeld, the leading independent lubricating grease manufacturer in the world, offers for your convenience, the most modern research and control laboratories in the industry, and a competent staff of lubricating engineers, all capable of handling most any lubrication problem that may arise.

A Battenfeld customer is a satisfied customer, because Bat's also offers efficient packaging methods, pool trucks to allow freight savings, a customer service department to supply you with the latest developments in the industry, through news letters and brochures, a selling aids library, and a sales promotion staff, just to name a few of the many services available.

Yes, YOU as a Battenfeld customer can enjoy these conveniences, be you large or small.

The next time you are faced with a difficult problem, why not sit down and write to a Battenfeld representative about your problem, whether it concerns lubrication, sales promotion, service, packaging, etc., and let one of our specialized departments work for you. You will be glad you did.

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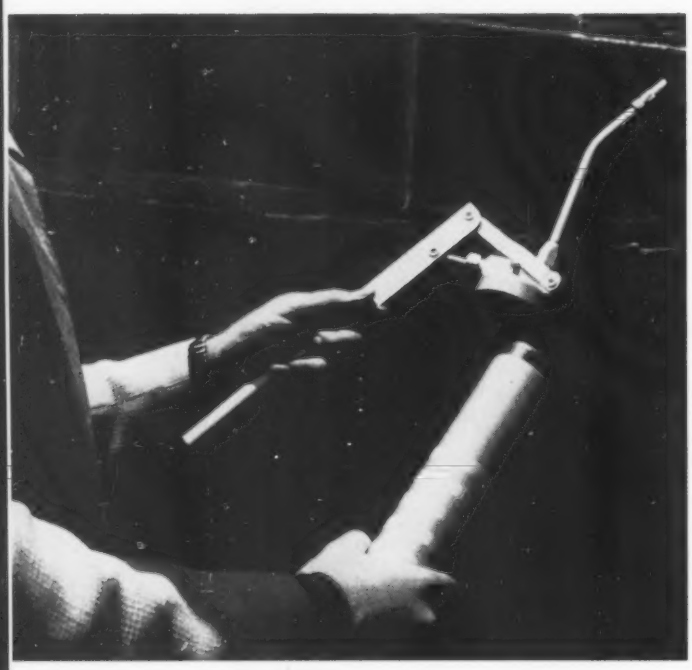


less" handling by the user. Loading by conventional "paddling" methods requires a minimum of five minutes and it is a rare grease handler who does not end up spattered with grease. Even the utilization of gun filling devices is time consuming with an element of mess—not to mention the time and effort required to attach the filling device to the container. In addition to the speed, convenience, and lack of mess, the cartridge completely eliminates waste. The gun plunger is designed to wipe the walls of the cartridge clean in direct comparison to 35-pound pails or larger bulk containers where as much as 10 per cent or 15 per cent of the lubricant remains on the sides or walls, ultimately to be thrown away.

Because the cartridge is factory filled and sealed, only to be opened during the actual moment of loading, contamination is virtually eliminated. This feature is probably more appreciated by the grease manufacturer and marketer than by the consumer. In our own operation, all the careful precautions against contamination are often nullified by careless handling and storage by the consumer after the grease leaves our control. More than 95 per cent of the complaints we receive are due to outside contamination of products *after* the consumer commences to actually apply the grease. Complaints of contamination of cartridge grease have been virtually non-existant!

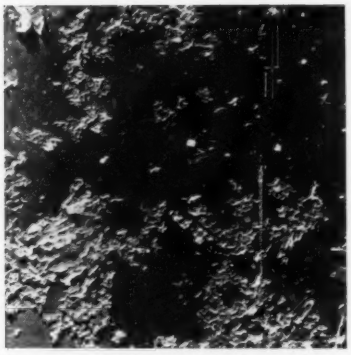
There are, of course, a great many other reasons why the public has accepted the cartridge package. Ease of storage and handling, more positive usage control, portability, more accurate inventory possibilities, stock and application simplification are only a few. One of the best reasons is the upswing in preventive maintenance by those companies using cartridge lubrication. By making it clean, easy and fast for an operator to reload and use his grease gun, the tendency has been for more frequent lubrication. This partially explains the odd fact that grease purchases by marketers has in every instance *increased* after entry into the cartridge type package.

At this writing, many major oil companies are either in the cartridge market or actively engaged in test programs of various degrees. A great many of the independents have put cartridges into their line with excellent results.

Competition of cartridge marketers is forcing non-cartridge marketers into the package in ever increasing numbers. Present forecasts indicate most petroleum

TOP, the cartridge loading grease gun is cocked, then (center) the pressure head is easily removed from the gun and (bottom) the user removes the double spring clip seal from the bottom of the cartridge. (Sequence contd.)

LITHIUM Base Grease:



1μ

Micrograph showing soap structure of lithium base lubricating grease made from 12-hydroxy stearic acid. Courtesy of Sinclair Research Laboratories, Inc.

ITS MULTI-Properties MAKE IT MULTI-Purpose

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- Non-corrosive
- Water resistant
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- Cold operating properties
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IN APPLICATION

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- Lubrication of plain and anti-friction rotating bearings
- Lubrication of vehicle chassis points, wheel bearings, universal joints and water pump
- Lubrication of high-temperature ball bearings
- Aircraft, artillery, instrument and general ordnance maintenance

IN MARKETING

- Lower inventory
- Less dispensing equipment
- No chance for misapplication
- Reduction in lubricating time
- One grease lubricates a vehicle

IN INDUSTRY

- Ordnance
- Manufacturing
- Farm equipment
- Transportation
- Industrial maintenance

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Lithium Corporation enjoys an established acceptance among grease makers—and for "multi-reasons" too: production experience, unsurpassed facilities, available inventory and immediate shipment—all combine to assure a reliable source of consistently uniform $LiOH\text{-}H_2O$. Since we are equally interested in developing better lithium products, why not get in touch with us on your lithium hydroxide problems? A card or letter will bring immediate response.

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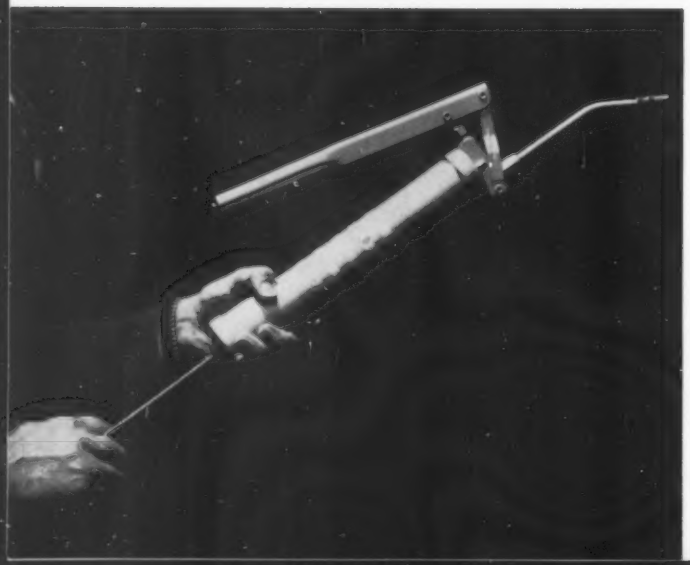

marketers in the United States will be committed to some form of a cartridge program within the next couple of years.

The cartridge idea is not new. Over thirty years ago an attempt was made to introduce grease cartridges into the market. A number of abortive attempts, have been made since then. Both independents and majors have toyed with the idea and some have actually started marketing programs. Even a large steel package manufacturer tried to introduce a metal cartridge shortly after World War II. In all instances the public failed to accept the package.

Probable reasons for failure are threefold. One was the lack of a suitable cartridge which would hold the lubricants through handling and long storage periods. Two, was the lack of a suitable cartridge loading grease gun expressly designed and precision manufactured for the unique cartridge requirements. Earlier guns were usually conversions of conventional guns. The third reason was the understandable reluctance of marketers to design, stock and sell *both* cartridge and guns as a package. Most marketers have traditionally been reticent about selling equipment. Low volume and low margins made the program unattractive economically.

The first drawback was mostly overcome through the efforts of an industry almost wholly foreign to ours. The paint industry, and more specifically, the caulking compound industry had for many years sought to overcome the problems of bulk caulk handling, loading and application. Caulking compound is a viscous, plastic material with much the same appearance and storage problems of lubricating grease. Caulk contains various oils such as vegetable, fish, linseed, soya, etc. It is generally used to fill cracks around windows, etc., and one of the requirements is that it must form a "skin" which may be painted over. This skin should form rapidly after exposure to the air, and should be paintable within 24 hours. Obviously this characteristic presented critical packaging problem. The material must be kept fresh and pliable for easy application; also, it must surface harden rapidly when exposed to the air.

After many years of trial and error, the caulk industry developed an airproof cartridge which would not soak up the oils in the caulk, and which would protect the material inside from exposure to air. Ex-

TOP. Insert the fourteen and one-half ounce cartridge, then (center) remove the top friction plug—clean, easy and fast. Next (bottom) replace the head, release the spring, and the cartridge gun is now ready for use.

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DEMONSTRATIONS to the customer in the field help boost this new package to a farmer using an irrigation motor.

cept for the special closures we designed and the size, this cartridge is essentially the one adopted for the grease cartridge. It consists of an inner liner composed of greaseproof or super-greaseproof paper, two or three layers of a chipboard or kraft paper, and an outside layer of an oil proof material. These layers are bound together through the use of special adhesives, and spiral wound (for strength) under heat and pressure. The result is an oil or greaseproof container structurally very strong, and yet flexible, with excellent storage ability. About eighteen months is the recommended storage life for caulk cartridges, and this should equally apply to grease cartridges. As with all things though, there are short cuts in cartridge manufacture and the grease marketer should make certain he is getting a cartridge which features all the built in protection possible. A cheap innerliner or "shorted" manufacturing process can result in sodden, grease soaked, useless inventory after a compartively short storage period.

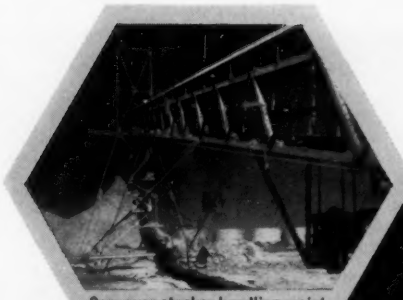
The gun problem solution can largely be credited to an Iowa farmer named Harold Deupree. Deupree, in addition to being a farmer, is an excellent machinist and designer. Some years ago he grew impatient with current grease dispensing methods and set out to design a gun he could use with pre-loaded cylinders of grease. Ultimately his efforts were successful and Deupree had an easy convenient method of greasing his machinery in the field.

The commercial possibilities were apparent to Mr. Deupree and he attempted to interest a number of grease gun manufacturers in his invention. He had no success. He then approached various petroleum companies. Again with no success. Container manufacturers were equally uninterested. The lack of interest by

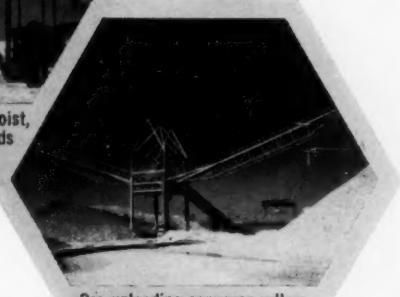
About the Author

C. E. Gore is sales manager of the Battenfeld Grease & Oil corporation. He joined Battenfeld several years ago and after an extensive training program was appointed southern sales representative before attaining his present position. A graduate of the Marine Corps Institute, Gore completed an extensive tour of duty during World War II and then entered the automotive parts field as salesman. He rapidly became a top volume producer and was appointed sales supervisor. Gore then joined a national retail marketing organization to become sales manager in the retail division, before joining Battenfeld. He is a past contributor to the NLGI Spokesman *and the NLGI Annual Meeting, and is a member of ASLE and AOA.*

"In 14 months...not a single bearing lubrication failure with lithium-base grease!"



Conveyor-stacker handling moist, sticky material which builds up on the rollers.



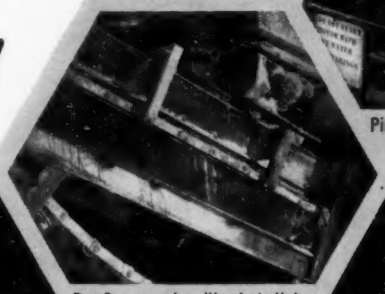
Ore unloading conveyor rollers handling 200 tons of ore per hour.

THE PROOF IS IN THE PERFORMANCE...

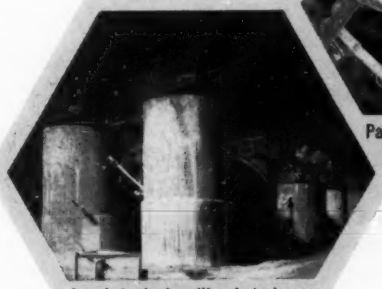
lithium-base grease does the job...

and does it better!

Pinion gear transmitting power from 600 h.p. motor to a ball mill.



Pan Conveyor handling hot clinker (1600°F), roller bearings in dusty, moist atmosphere.



Leach tanks handling hot slurry, agitators driven by Falk gear reducing units.

V.A. Wemco classifier, part of wet grinding system, lower bearing submerged in hot sludge.

Here's a report of our own experience with lithium-base grease under extreme industrial service conditions. Approximately 95% of the grease used in the plant of AMERICAN LITHIUM CHEMICALS, Inc., our subsidiary at San Antonio, Texas, is lithium-base, one-type grease. In fourteen months operation we have not been able to trace a single cause for bearing failure to the lubricant used. The on-the-spot photos above give graphic evidence of the rugged bearing service requirements in this plant where lithium ores are processed into high-grade lithium hydroxide, itself an important ingredient in lithium-base grease. Performance like this is why grease chemists, manufacturers, marketers and users all attest to the superiority of lithium-base... the *one* grease in place of *many* for efficient and economical operation.

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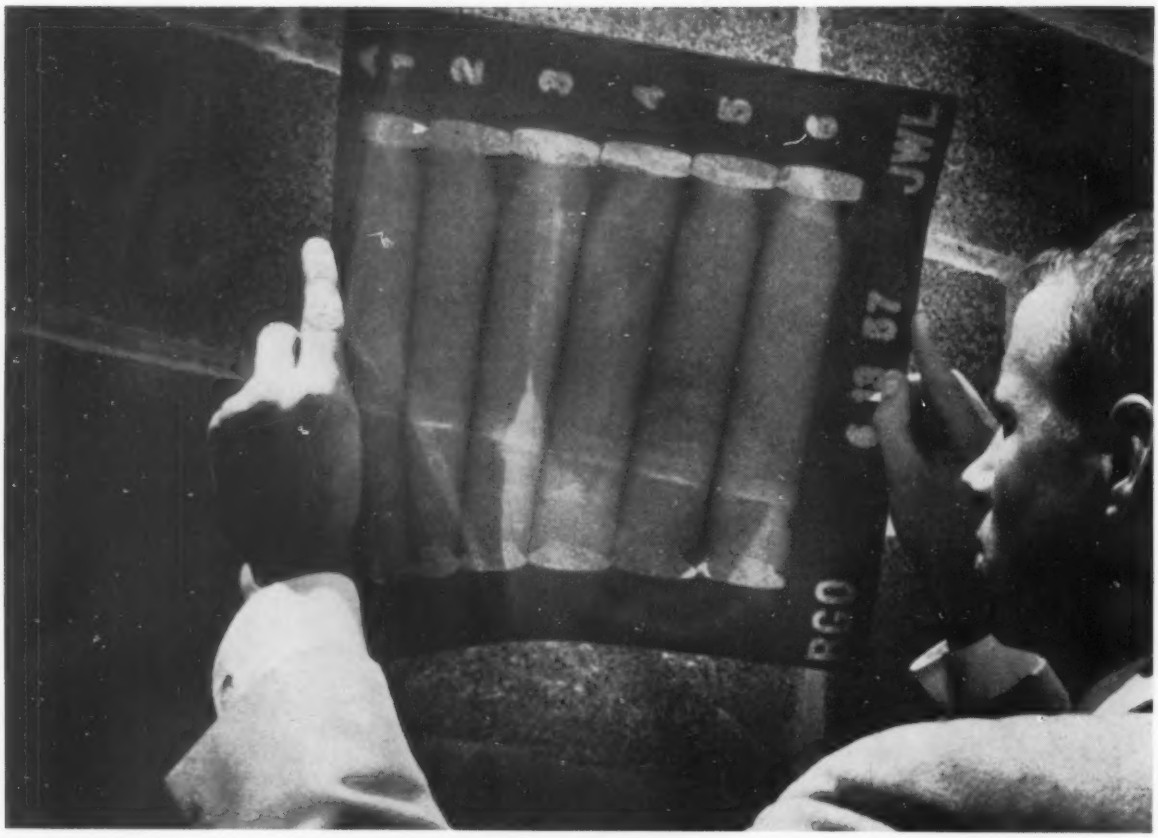


PRECISION control is necessary, so X-ray shots are used to insure that cartridges are free from possible faults.

all three classes of industry was understandable. A gun manufacturer could not justify the capital investment etc., necessary to produce a product for which there were no cartridges available and no market existing. The same was true of container people. Why make a new special size container to fit a gun which did not exist in commercial quantities? Few, if any, oil companies are equipped to design, develop, procure or manufacture two items, (cartridge and gun) both of which are completely outside the industry. Particularly when the lubricating grease in many instances is not even manufactured by the marketing company.

Eventually Deupree brought his idea to us where the possibilities were at least partially seen. Arrangements were made to have the gun manufactured, specifications were laid down on cartridges and a marketing program developed by the sales department.

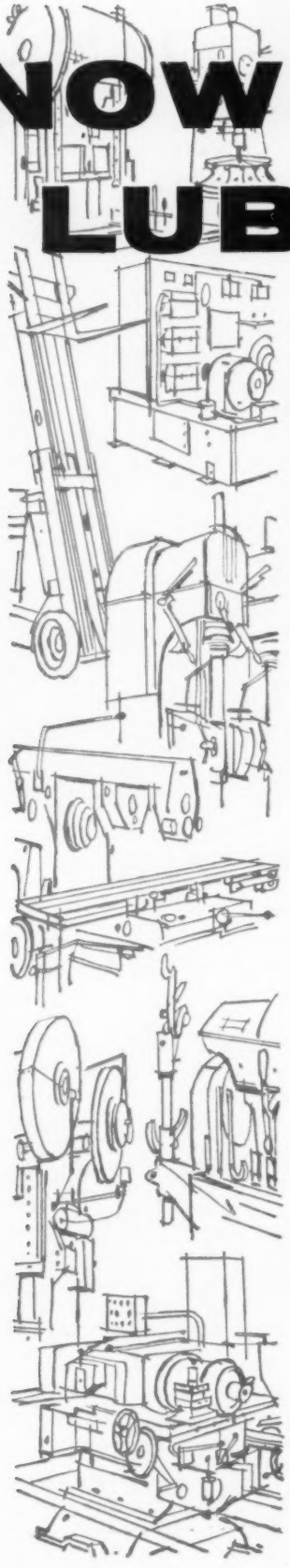
Much water has gone over the dam since those days just two years ago. Battenfeld sales of the cartridges are now in the multi-million category. It is now commonplace to place orders for empty cartridges by the million! The sales promotion program has grown from a couple of hand out brochures to full scale product-sales-marketing-training program for accounts who are interested in the cartridge package.

A note of caution to the prospective cartridge marketer: make sure your cartridge is correctly designed and has utilized quality materials. Make sure the cartridge closures are leakproof, and will compensate for expansion and contraction. Make sure the grease gun selected is expressly engineered for cartridge use, and not converted over from a conventional gun.

And make certain your sales force is fully informed on where and how to market the package. Battenfeld has found that field representatives need enthusiasm and knowledge to insure the success of a sales program.

The grease cartridge is undoubtably one of the most spectacular aids that has been introduced into the lubricating grease field. Proper supply of quality components and a sound, aggressive marketing program will insure that you and not your competition—will gain the maximum benefits already proven obtainable with this new marketing tool! ■

NOW! ATLANTIC LUBRICANT 54



...the one lubricant for practically every industrial need

New Atlantic Lubricant 54 is industry's closest approach to the universal grease lubricant. The use of this distinctively purple grease in your plant practically assures the correct choice in any application. It has given outstanding performance in all types of machinery.

Every shop, large or small, can make economical use of Atlantic Lubricant 54 because it gives

- ...multiplicity of use—reduces chance for error, cost of warehousing, and handling
- ...outstanding rust protection—protects ferrous surfaces under wet conditions
- ...excellent lubrication performance from very low to extremely high temperatures
- ...unusual stability against oxidation and softening under rugged working conditions
- ...positive identification due to its purple color

This product is available from warehouses conveniently located throughout Atlantic's marketing territory and may be ordered through the nearest office listed below. Department Y-8.

ATLANTIC

LUBRICANTS • WAXES
PROCESS PRODUCTS

PHILADELPHIA, PA.
260 So. Broad St.

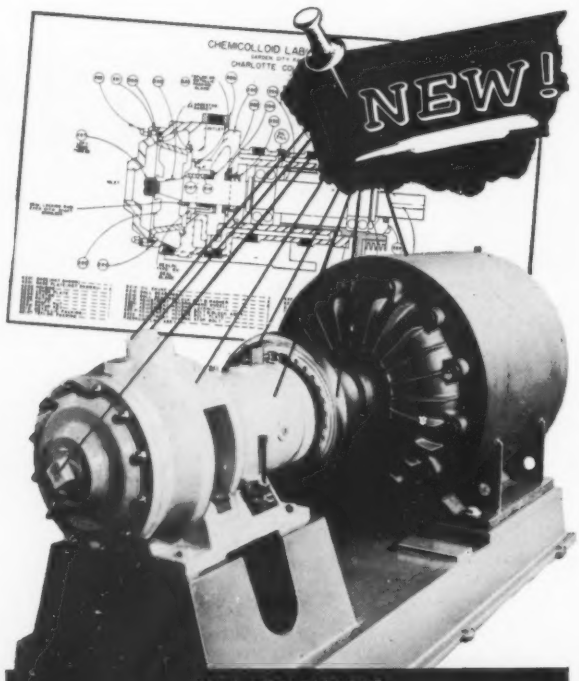
PITTSBURGH, PA.
Chamber of Commerce Building

PROVIDENCE, R. I.
430 Hospital Trust Building

SYRACUSE, N. Y.
Salina and Genesee Streets

READING, PA.
First and Penn Avenues

CHARLOTTE, N. C.
1112 South Boulevard



the new
"CHARLOTTE"

8 NEW VITAL POINTS OF IMPROVEMENT

- New Front End Removable Seals
- Increased Capacity
- Increased Horse Power
- New Hand Wheel Locking Device
- New Quick Disconnect Coupling
- Increased Cooling Surface
- Oversize Radial and Thrust Bearings
- New Base Design

We are confident the new "G" Series will be the answer to the grease industry in that it embodies all the improvements asked for. It contains more than thirty years experience of manufacturing the Charlotte Colloid Mill.

for detailed information call or write–

CHEMICOLLOID
LABORATORIES, INC.
55 Herrick Road · Garden City Park, L. I.

Technical Committee Column

CHAIRMAN T. G. ROEHNER, Manager, Technical Service Laboratory, Socony Mobil Oil Company, Inc.

The first meeting of the Joint SAE-NLGI Committee on Chassis Lubricants was held on June 4, 1957 in Atlantic City, New Jersey. SAE was represented by:

C. W. Georgi, Quaker State Oil Refining Corp.
M. D. Gjerde, Standard Oil Co. (Indiana)
H. L. Hemmingway, The Pure Oil Company
N. Hunstad, General Motors Research
Gus Kaufman, The Texas Company
William Marble, SAE Headquarters
D. Miller, Chrysler Engineering
R. Potter, Ford Engineering
Lloyd Withrow, General Motors Research

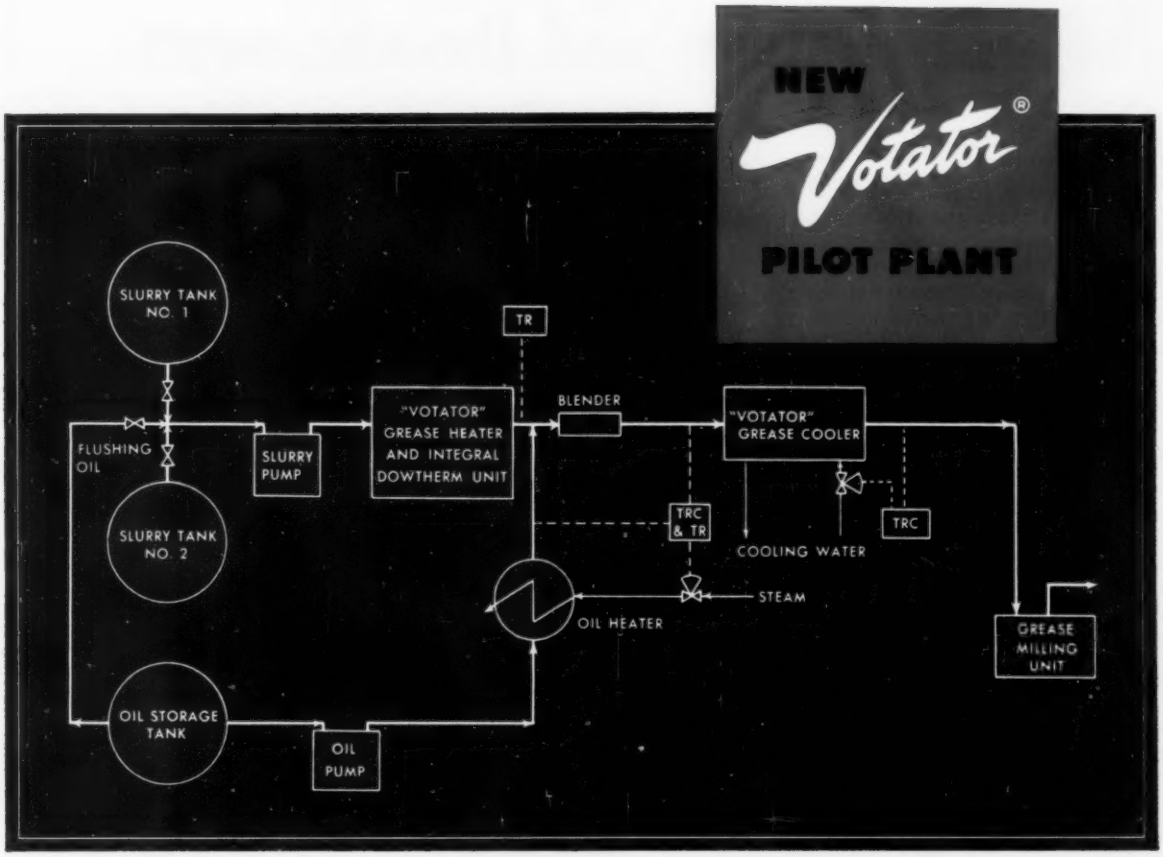
NLGI representatives were:

M. Ehrlich, American Lubricants, Inc.
J. J. Kolfenbach, Esso Research & Engineering Co.
J. W. Lane, Socony Mobil Oil Company, Inc.
T. G. Roehner, Socony Mobil Oil Company, Inc.
J. B. Stucker, The Pure Oil Company

Encouraging progress was made in discussions of problems of mutual concern to both industries. It was agreed that the committee would not submit recommendations for revision of the chapter on automotive lubricating greases in the latest issue of the SAE Handbook until further discussions led to better understandings of the objectives to be achieved by that chapter. It was also agreed that work would be started on a write-up of Recommended Practices for Lubricating Ball Joint Bearings. This project will be guided by NLGI's experiences in the preparation of Recommended Practices for Packing Front Wheel Bearings.

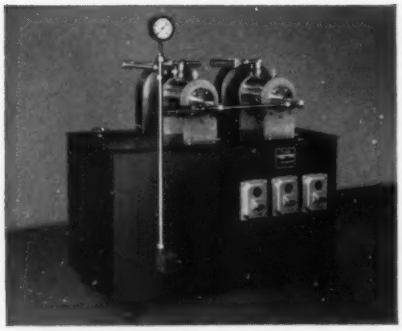
The agenda for the symposium on "Fundamental and Practical Aspects of Bleeding of Lubricating Greases" to be held during the October meeting of the Technical Committee is almost completed. It will include a number of papers which will certainly contain data of immediate interest to the members and should lead to a productive question and answer session.

NLGI SPOKESMAN



NEW *Votator*® PILOT PLANT

simplifies research in lithium grease and specialty lubricants



VOTATOR Grease Blending and Cooling Unit of grease pilot plant.

To help you develop improved methods and formulations, Girdler now makes available a complete, compact pilot plant for processing of lithium greases. This new VOTATOR* Grease Processing Equipment can also be used for small-scale, continuous production of specialty lubricants such as diesters and silicones. Schematic flow chart for the plant is shown above. Its features:

VOTATOR grease heater has integral electrically heated Dowtherm vaporizer.

All process variables such as temperatures and throughput rates can be changed in a few seconds.

Variable capacity pumps allow rapid change of slurry and oil ratios for easy study of various soap concentrations.

Variable drives on heater, blender and cooler permit easy study of processing alterations at all stages.

Write today for further information on this new VOTATOR Grease Pilot Plant. The Girdler Company, Votator Division, 224 East Broadway, Louisville 1, Ky.

*VOTATOR—Trade-Mark Reg. U.S. Pat. Off.

The **GIRDLER** Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

VOTATOR DIVISION: New York • Atlanta • Chicago • San Francisco

Patents and Developments

Extreme Pressure Lubricating Grease

U. S. Patent 2,790,770 issued to Morton Fainman and Reuben A. Swenson, assigned to Standard Oil Company (Indiana). Exceptionally high Timken values are developed for extreme pressure lubricating grease by incorporation of 1-20% by weight of a lead soap of sulfurized tall oil and a small, apparently catalytic amount (0.5-2%(organic polysulfide, such as dodecyl pentasulfide. For optimum results, a second oil-miscible lead soap should be added in sufficient amounts to provide a lead to sulfur ratio of about 3:1 or somewhat higher. A lithium hydroxystearate grease containing 5% lead sulfurized tallate, 0.1% dodecyl pentasulfide and 1.5% lead fish oil soap was found to give passing Timken values of 50-55 pounds, compared to 40 pounds for the best available competitive product.

Water-Resistant Gels for Greases

U. S. Patent 2,790,776 to William E. Savage and Walter H. Peterson, assigned to Shell Development corporation. The presence of a certain limited amount (50-150 parts) of oil together with 10-150 parts) of a hydrophobic surface-active agent (hydroxypolamine) and an inorganic colloid (such as silica) has been found to enable the use of spray drying to produce a product capable of improved gelling power when dispersed in oils. Additional presence (2-50 parts per 100 parts of inorganic gelling agent) of a volatile polar liquid (water or alcohol) in the solid spray dried product improves the ease with which the latter is subsequently dispersed in oils. A hydrogel of the inorganic gelling agent is made first and the oil and surface-active agent are mixed in and the mixture is homogenized prior to spray drying at 50-110° C. Residual water may be removed by a second spray drying operation.

Greases by Alkali Fusion of Fatty Materials

U. S. Patent 2,790,769 to Arnold J. Morway and Alan Beerbower, assigned to Esso Research & Engineering company. High temperature greases are prepared from a thickening agent (fatty acid soap) obtained by saponification of the product obtained by heating glycerides (tallow and other fats rich in stearin) at high temperature above 520° F.) in presence of alkali. The first stage consists in slowly heating the reaction mixture (fat with at least twice the amount of alkali needed for saponification) until neutralization is completed. Then, heating is continued at 530°-570° F. until foaming caused by gas evolution ceases. Greases made from these soaps resemble those made from rapeseed oil and require addition of 1/4-2% of an oil-soluble sulfonic compound from petroleum to increase the soft and unctuous quality and temperature stability.

Grease Compositions Containing Complex Alkaline Earth Metal Salts

U. S. Patent 2,790,767 issued to John J. Giammaria, assigned to Socony Mobil Oil company. Grease compositions containing as gelling agents, the complex alkaline earth metal salts of acetic acid and of partial esters of phosphoric acid are prepared for high temperature use (200°-500° F., and higher). The complex salts are prepared by first making a partial ester of phosphoric acid by reacting phosphorus pentoxide with and alkyl-substituted, hydroxy-aromatic compound (e.g. and alkyl phenol) in which the alkyl portion contains 8-14 carbon atoms. The ester then is reacted by one of three methods: (1) reacting

Continued on page 38

McGEAN 30% LEAD NAPHTHENATE ADDITIVE

Consistently uniform in metallic content and viscosity

Fully clarified by filtration

Non-Oxidizing - - - contains no unsaturated soaps

Free from low flash constituents

your inquiries solicited

THE McGEAN CHEMICAL COMPANY

MIDLAND BUILDING • CLEVELAND 15, OHIO

Detroit • Grand Rapids • Chicago

FISKE BROTHERS REFINING CO.

Established 1870

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NEWARK, N. J.

TOLEDO, OHIO

★

Manufacturers of

LUBRICATING GREASES

"What are we doing about uniform quality and prompt delivery of steel containers?"

"We're getting high quality from J&L ... and they have a plant near every one of ours."

- J&L steel containers provide engineered packaging for dependable transportation and safe storage.
- J&L specialists, backed up by modern research, are ready to consult on your toughest packaging problems.
- Precise fabrication and correct specification of fittings and closures.
- Prompt dependable delivery from nine plants.
- J&L, an integrated steel producer, controls container quality from start to finish.

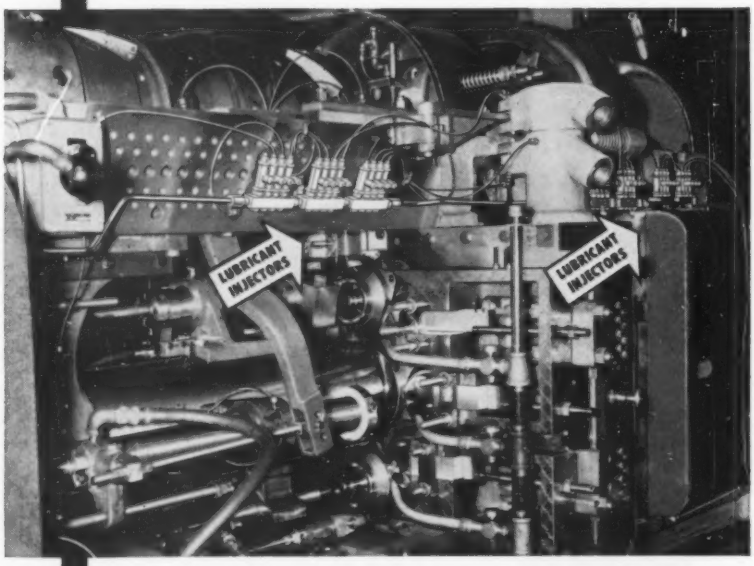
Call your nearest J&L Container Division office for recommendations on your packaging problems. Or write direct to the Container Division, 405 Lexington Avenue, New York 17, N.Y.

Jones & Laughlin
STEEL
...a great name in steel

Lincoln POWER DRIVE

Reduces Maintenance Costs... Ends Lubrication Down-Time!

Revolutionary Centralized Power-Drive Systems for Automated Machine Groups and Components.



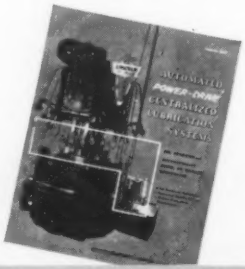
Lincoln "mechanized maintenance" at work: Simultaneously, each time System is cycled, Heavy Duty Way Oil is supplied to lubricant injectors, serving 78 bearings.

Engineered for Positive, Reliable Lubrication

Lincoln's new Power Drive Systems are especially designed and engineered to save you valuable man-hours, boost your production, and put an end to needless repairs. A premeasured film of refinery pure lubricant is automatically applied to bearings at predetermined, self-controlled time intervals. Proven throughout industry in a wide variety of applications, these low-cost systems increase service life of equipment... pay for themselves in no time.

Send for new free bulletin

Complete information on how to "build in" automatic maintenance for automated lines ... machine tools ... production equipment ... and materials handling equipment... Write today for Bulletin 806-R.



Lincoln *Trade Name Registered

THE MOST TRUSTWORTHY NAME IN LUBRICATING EQUIPMENT

LINCOLN ENGINEERING COMPANY
Division of The McNeil Machine & Engineering Co.
5702-30 Natural Bridge Ave. • St. Louis 20, Mo.

a mixture of the ester and acetic acid with an alkaline earth metal oxide or hydroxide, (2) reacting the ester with a salt of an alkaline earth metal to form the normal metal salt of the partial ester and then further reacting the normal metal salt with an alkaline earth metal acetate, or (3)reacting the ester with enough alkaline earth metal acetate- to provide the complex salt without intermediary formation of normal salt. Each of the three methods require a temperature of at least 400° F. (preferably 400°-500° F.), and a heating period of 0.1-2 hours.

NEWS ITEMS

Gamma radiation severly damages colloidal structure of lubricating greases made with conventional soap as gelling agents, but substitution of synthetic aromatics for the soap made possible greases much more resistant to radiation, according to California Research corporation. Greases were also improved by using specially synthesized alkylaromatic oils such as octadecyl-a-methyl naphthalene and pentapropylene-a-methyl naphthalene. This improved grease is said to be still soft after paraffinic oil grease has solidified (Chemical and Engineering News 4/29/57, p. 28).

Lubricants in nuclear power plants—Behavior under irradiation, lubrication of a typical nuclear power plant, lubricant disposal, etc. (Housman et al, Oil-Power, 12/56, p. 12.)

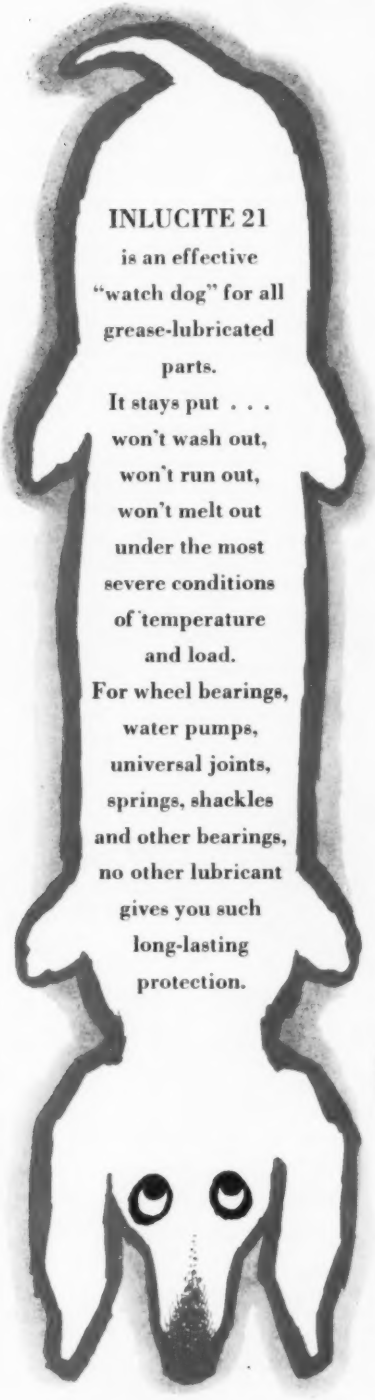
New British heat-resistant greases based on moly disulfide and modified bentonite are claimed to give efficient lubrication at 100,000 p.s.i. in machinery operating continuously at up to 450° F., according to Rocol, Ltd., Swillington, Yorks, England (Chemical Week 2/16/57, p. 96).

Other U. S. Patents

2,781,953 (Charles H. Sylvander) —Greasing ram device with plunger to boost pressure.

2,788,088 (Roy Weston)—Nipple for pressure lubrication.

2,792,154 (Phillans L'Heureux) —Ratchet lever hand grease gun.



INLUCITE 21
is an effective
"watch dog" for all
grease-lubricated
parts.
It stays put . . .
won't wash out,
won't run out,
won't melt out
under the most
severe conditions
of temperature
and load.
For wheel bearings,
water pumps,
universal joints,
springs, shackles
and other bearings,
no other lubricant
gives you such
long-lasting
protection.

INTERNATIONAL LUBRICATION

Lithium-Base Multi-Purpose

INLUCITE 21

makes vital wearing parts last

LONGER

INTERNATIONAL LUBRICANT CORP.

NEW ORLEANS, LOUISIANA

Manufacturers of Quality Lubricants • AVIATION • INDUSTRIAL • AUTOMOTIVE • MARINE

With Research Comes Quality, With Quality Comes Leadership

People in the Industry

Thomas Moves Shell Midwest Offices to Chicago

The vice president in charge of Shell Oil company's midwestern marketing divisions has moved his office from New York to Chicago, it was recently announced.

The new headquarters are at 624 South Michigan Ave., where the firm's Chicago division office is also located.

P. C. Thomas, the Midwest vice president, said the move was made to provide more convenient administration in the area for which he is responsible. This includes all the marketing activities centered in Shell's Cleveland, Detroit, Indianapolis, Minneapolis, St. Louis and Chicago divisions.

F. H. Staub, sales assistant to Thomas, will also make his headquarters there.

Thomas, a native of St. Louis, joined Shell as a salesman in St. Louis in 1932. He advanced through executive positions in marketing, including those of district manager in Houston, division manager in St. Louis and Los Angeles, and general sales manager for the East Coast and for the West Coast. In 1954 he was named general manager for the Midwest. He has been a vice president since 1956.

Staub joined the company as a salesman in 1937. He later served as district manager in the Albany and Cleveland divisions and as sales manager in the Minneapolis and St. Louis divisions. Most recently he was special assistant to the general manager of the firm's head office marketing departments.

Kemmerer Named Shell Manager

Harold R. Kemmerer, assistant manager of Shell Oil company's manufacturing research department, has been named manager of the company's products application department.

Kemmerer succeeds A. B. Culbertson, who retired July 1 after

MALMSTROM NIMCO BRAND WOOL FAT & LANOLIN

Lubricating grease manufacturers know that top value and peak performance go hand-in-hand. That's why Malmstrom's NIMCO brands are specified. N. I. Malmstrom – largest processors of wool fat and lanolin products – produce quality components for grease production.

N. I. MALMSTROM & CO.

America's Largest Processor of Wool Fat and Lanolin

147 Lombardy St., Brooklyn 22, N. Y.
612 N. Michigan Ave., Chicago 11, Ill.

COMMON DEGRAS
NEUTRAL WOOL GREASE

A small percentage of NIMCO Wool Grease Fatty Acids—naturally saturated fatty acids (free from rancidity)—gives your grease top stability, better performance. Write today for working sample.

WOOL GREASE FATTY ACIDS

Moisture	2% max.
Unsaponifiable (Wool Grease Alcohols)	6% max.
Saponifiable	94%
Free Fatty Acid (as oleic)	55-60%
Actual Free Fatty Acid Content	90%
Saponification No.	120-130
Free Inorganic Acid	0.2% max.
Iodine Value	20-40
Apparent Solidification Point (titre)	Approx. 44° C.
Softening Point	45-48° C.
% Sulfur	No corrosive sulfur

A.O.C.S. Methods

33 years' service with the company. J. D. Heldman, special technologist in the manufacturing operations department, will replace Kemmerer.

The personnel changes were announced by M. P. L. Love, Shell's vice president in charge of manufacturing.

Kemmerer was graduated from the Pennsylvania State university with a degree in chemistry. He joined Shell in 1935 as a junior mechanical engineer at the company's Wood River, Ill., refinery. He has served as chief research chemist and department manager at the Wood River refinery and research director at Shell's Houston, Tex., refinery. He assumed his present duties in 1950.

Culbertson, a graduate of Missouri university, began his career with Shell in 1923 as assistant chief chemist at the company's Arkansas City, Kans., refinery. He was transferred in 1925 to the company's Norco, La., refinery as chief chemist and three years later became chief stillman. In 1930 he was named chief technologist at Norco, and was transferred to head office manufacturing in St. Louis in 1932. He became manager of the products application department in 1940. During World War II he served as assistant director of refining for the Petroleum Administration for War.

Kerr-McGee Announces New Chicago Salesman

Kenneth G. Jacobsen has joined the lubricating oil sales department of Kerr-McGee Oil Industries, Inc. Mr. Jacobsen's headquarters are in the Chicago office, 332 S. Michigan Avenue. He was formerly associated with the Pennsylvania Grade Crude Association.

Jones & Laughlin Promotes T. E. Crawford

T. Eugene Crawford, 100 West 52nd Street, Kansas City 12, Mo., has been promoted to mid-continent sales manager for the container division of Jones & Laughlin Steel corporation.

Mr. Crawford formerly was district sales manager in the container division's Kansas City district sales office. He will be headquartered in Kansas City.

A native of Kansas City, Mr. Crawford joined J & L as a sales representative in the Kansas City office in 1945. He was promoted to district sales manager in 1948.

Prior to joining J & L, he was employed in various positions by the Kansas City Southern railroad, the Kansas City water department, and Sheffield Steel corporation, also of Kansas City.

Aro Appoints Spangler Sales Promotion Manager

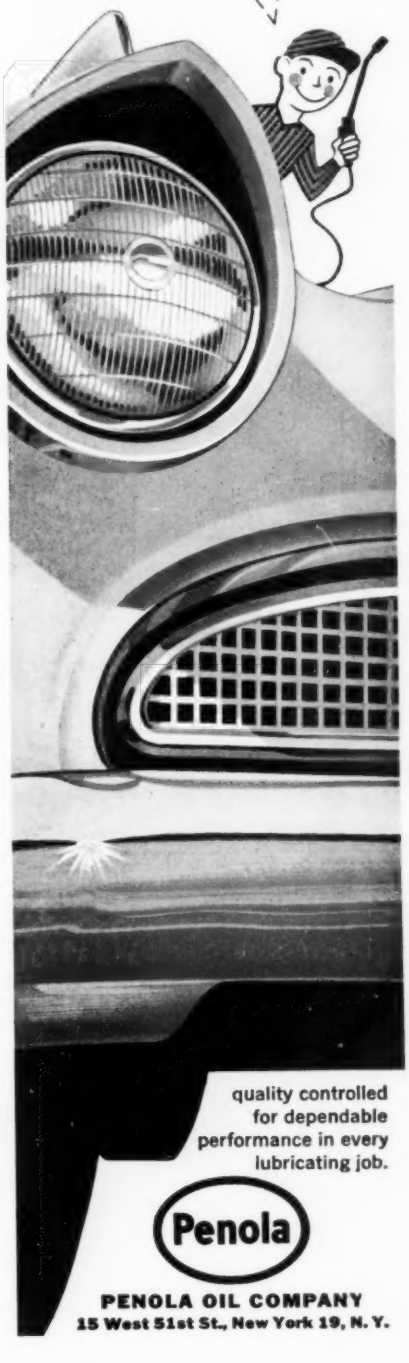
The Aro Equipment corporation of Bryan, Ohio, manufacturers of lubricating equipment, aircraft products and industrial air tools, announces the appointment of Robert P. Spangler as sales promotion manager of the Arolube division.

Experienced Merchandising Man

Mr. Spangler has much experience with merchandising and sales promotion in the lubrication field. He began his business career in Peoria, Illinois, as a salesman for Deep Rock Oil corporation in 1933. Since that time, he has also served as an automotive jobber salesman in both Peoria and St. Louis, Missouri. During World War II, he served for two years in the U. S. Navy in the South Pacific area. He then became a new car dealer operating an agency in Mattoon, Illinois, for a number of years. Most recently he served as sales manager for a manufacturing concern, until joining Aro in May of this year.

Mr. Spangler is making his home in Bryan, Ohio, with his wife and two children.

for smooth action...
always specify
PENOLA AUTOMOTIVE LUBRICANTS



quality controlled for dependable performance in every lubricating job.

Penola

PENOLA OIL COMPANY
15 West 51st St., New York 19, N. Y.

Industry News

New York Stock Exchange Approves Foote Mineral Application

Aplication for listing of the common stock of Foote Mineral company on the New York Stock Exchange was approved recently by the Exchange's Board of Governors. Trading may begin before the first of August, after certification by the SEC.

Dow Corning Circulates Silicone-Base Grease Brochure

Just out: a new brochure devoted to the properties and performance of Dow Corning 41, a most versatile new silicone-based grease.

Developed primarily for high-temperature, slow-speed bearings, it has become an industry standard for uses ranging from worm-and-pinion sets to compressor engine injector valves; from hold-down bolts to plastic extruder nozzles.

Examples of these and other applications in *current* use, some of them dating back as far as 1948, are described in detail. Four pages, two colors. Code No. 6-206.

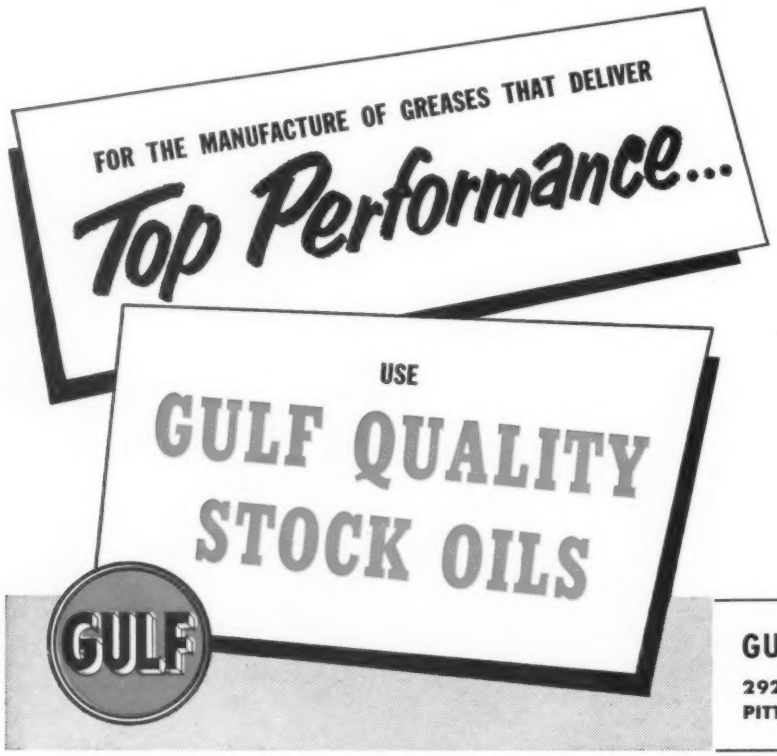
Sulfonate Plant Opens; First of Kind in Canada

Canada's first continuous-process plant for the production of oil-soluble sulfonate — the additive that puts the cleaning powder in modern high-detergency oils—was recently placed in operation by Surpass Petrochemicals Ltd.

The new $750,000 plant is geared to an annual capacity of 5,000,000 to 7,000,000 pounds per year of 60 per cent active oil-soluble sodium sulfonates. James E. Shields, Surpass president, said that it is expected to meet almost the entire demand of both Canada and the United Kingdom for such sulfonates, a demand that has heretofore been met by imports.

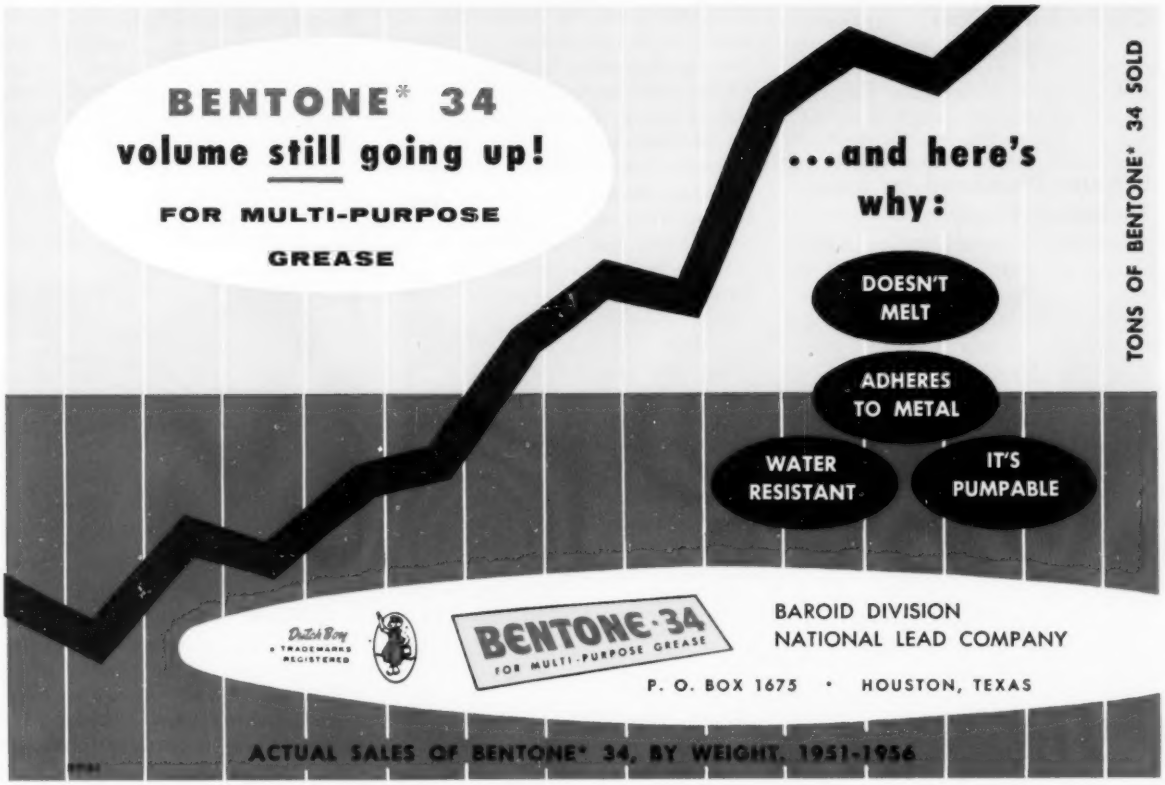
Heart of the plant, which was designed and engineered by the Girdler company division of National Cylinder Gas company, are two Votator multiport injection reactors that eliminate conventional kettles and bulky, time-consuming batch operations with a compact arrangement of automatically controlled continuous-process equipment.

Engineers explained that the Votator reactors, produced by Gridler in Louisville, Ky., make the temperature control and process operation virtually automatic for the



A COMPLETE line of stock oils, quickly available to you through strategically located warehouses, terminal facilities, and refineries in 31 states from Maine to New Mexico. Also quality petrolatums.

GULF OIL CORPORATION
2927 GULF BUILDING
PITTSBURGH 30, PA.



critical sulfonation and neutralization steps, and do it in a working space less than half that required for conventional production.

Approximately two-thirds of the oil-soluble sodium sulfonate production will be sold as additives for modern motor oils, where a solution of about five per cent of the sulfonate gives the oil the quality that keeps the walls of automobile and other engines clean.

The new plant will also be equipped to make other petroleum sulfonates such as those containing lithium, calcium, barium, ammonia or amine. Petroleum sulfonates are also used for cutting oils, agricultural sprays, certain applications in the textile field, including dry cleaning fluids, and rust inhibitors.

Surpass' new plant (at 36 Upton Road, Scarborough, a Toronto suburb) is adjacent to its recently opened facilities for the manufacture of lithium grease, the multi-purpose lubricant that is capturing markets once demanding many special types of greases. This plant, also designed and engineered by Girdler with automated production centered around Votator heat-exchange apparatus, is the first continuous-process lithium grease plant in Canada and the second of its kind in either the U.S. or Canada. Though occupying floor space of less than 400 square feet, it is capable of producing 25,000,000 pounds of grease a year.

Surpass is a subsidiary of Montgary Explorations Ltd., Toronto.

Check-Chart Readies Lubrication Guides

Publication of the 1957 edition of the Motor Oil and Gear Lubrication Recommendations booklet has been announced by the Chek-Chart corporation, Chicago.

The new edition embodies modifications in styling, designed to increase the efficiency of the booklet as a pocket-sized reference. It also features the addition of truck cooling system capacity data.

For passenger cars, trucks, tractors.

Also released by Check-Chart is the 1957 Automotive Lubrication Guide. It contains complete, manufacturer-approved lubrication recommendations for all U. S. passenger cars and light trucks in diagrammatic form, plus tabular data

Chek-Chart

Continued from page 42

on popular European passenger cars and many other exclusive features, as well as general service information.

Lithium Discussed in Technical Study

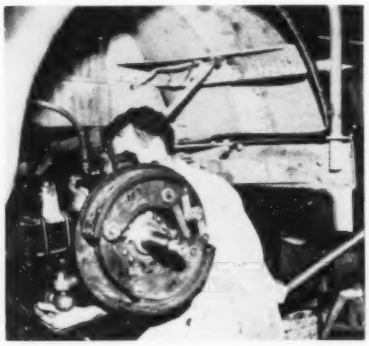
Lithium, currently finding widespread use both as a metal and in various compounds, is one of the alkali metals discussed extensively in a new volume recently published by D. Van Nostrand Co., Inc., Princeton, N. J. The book is the sixth in a planned series of eleven volumes called "Comprehensive Inorganic Chemistry." Authored by Robert C. Brasted and John F. Suttle the volume is entitled "The Alkali Metals–Hydrogen and Its Isotopes." Brasted and M. Cannon Sneed are editors of the complete series.

Lightest of the metals, lithium, in addition to its application as an alloy, can be used to form many compounds, each of which has advantages in particular end uses. Among the many applications for lithium and its compounds today are ceramics, automotive greases, air conditioning, welding, storage batteries, metal refining, catalysis, pharmaceutical manufacture, electrochemistry, inorganic chemistry, propellents, and electronics.

In order to emphasize the differences between the various alkali metals–lithium, sodium, potassium, rubidium, cesium, and francium–these materials are discussed jointly in the unique 248 page work. Illustrated throughout with more than fifty comparative charts and tables, the book is a comprehensive study of the chemical properties, occurrence, preparation, alloys, properties in liquid ammonia, and analytical chemistry of these metals and their compounds. A noteworthy feature is the large number of phase and solubility diagrams of the various compounds of these elements.

Readying for Moly-Sulfide Road Run

Front axle being reinstalled on truck, one of thirty vehicles being used in road tests as Southwest Research institute, San Antonio, Tex., to evaluate the effectiveness of Moly-Sulfide additive in chassis grease. In these road tests, now un-



TRUCK installation on front axle.

der way, thirty vehicles – city busses, tractor trailers, and police cars–will travel a total of 1,500,000 to 2,225,000 miles.

Half the vehicles of each type are lubricated with commercial grease, the other half with the same grease in which 3% Moly-Sulfide has been dispersed. Wear will be determined by before-and-after weight comparisons, dimension measurements and surface inspection of key parts.

Prior to testing, critical parts such as wheel bearings, king pins and bearings, ball joints, brake act-

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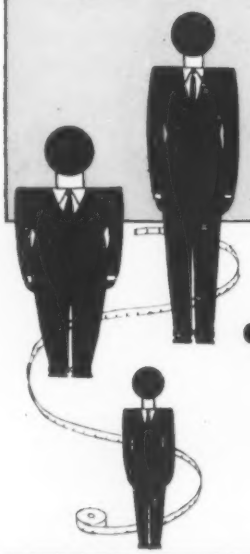

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uating cams, bushings, shackle pins and bushings, tie rod ends and steering linkage are replaced with new parts, as is being done in photo. Parts are weighed and measured before installation. During test all are lubricated and inspected at regular mileage intervals. At the conclusion, parts will be removed, cleaned and weighed and measured to determine actual wear, and the effectiveness of Moly-Sulfide chassis grease additive in preventing wear.

The tests, sponsored by Climax Molybdenum company, are expected to be concluded early this summer.

Moly-Sulfide Smoothes Scissors Output

A squirt of molybdenum disulfide-containing lubricant on scissors blanks means increased die life, greater production and a better finish to the final pieces turned out at the Acme Shear company, Bridgeport, Conn., plant. The lubricant aids in the cold forging or coining process, carried out in the 650-ton press in the left background, by allowing the metal to flow. Transferred to the die during the forming, it extends die life substantially, and permits a slight reduction in pressure used in the press.

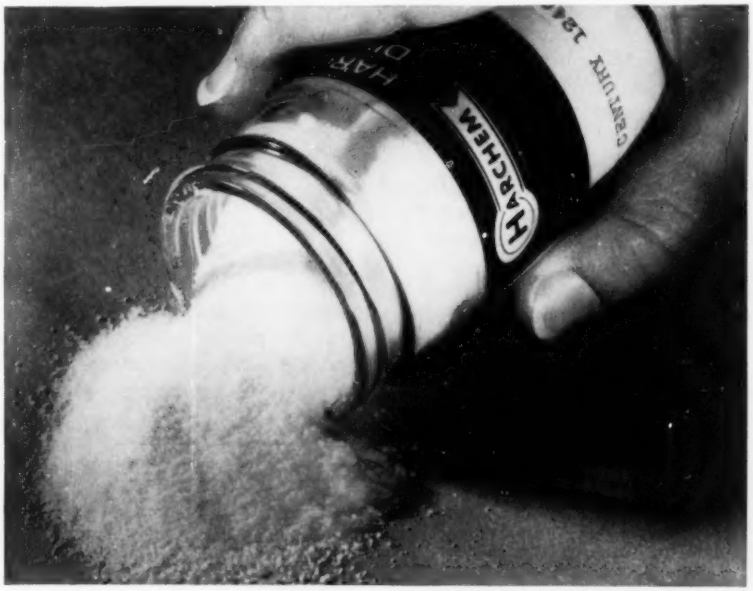
Prior to using the MoS_2 lubricant, Acme used no lubricant since most lubricants, wet or dry, tend to pile up in the die if used in excess, and form an imprint of the cold-forged piece. By carefully distributing the Moly-Sulfide powder, the operator can avoid any accumulation of lubricant and obtain production advantages without fear of damaging pieces. Moly-Sulfide is particularly well suited to such an application since it films out on metals in thin tenacious layers to give lubrication under severe conditions of use.

ACME shear now lubricates scissors with MoS2 for increased die life.

Research Continues on Rape Seed Oil Greases

Information published in the NLGI SPOKESMAN concerning the development of rape seed oil for use in lubricating greases was inadvertently furnished NLGI from an investigation which has not yet

Continued on page 46



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H-27

Research Continues

Continued from page 45

proceeded sufficiently to merit a preliminary report . . . readers taking action from a June NLGI SPOKESMAN news feature should be so advised.

Considerable research is being carried on for uses of rape seed oil, by a grease lubrication committee comprised of representatives from the National Research Council of Canada, the Saskatchewan Research Council, the Saskatchewan Wheat Pool, the Western Oil company, Federated Co-operatives Limited and the J. Gordon Ross syndicate. G. A. Ledigham of the National Research Council is chairman of the grease lubrication committee.

The investigation is continuing and the manufacture of properties of rape seed oil greases are being made on an experimental basis in the Western Oil laboratory. The NLGI SPOKESMAN hopes to offer further data upon authorization of the organizations mentioned above.

Alpha Molykote Opens Technical Service Division

The organization of a technical services division to handle the growing demand for engineering information on its line of molybdenum disulfide lubricants has been announced by the Alpha Molykote corporation, Stanford, Connecticut.

According to Alfred Sonntag, president, the new division will be under the direction of Harry S. Gerstung, former chief automotive engineer of Sinclair Oil company.

At the same time as he made the appointment of Harry S. Gerston to the technical services division, Mr. Sonntag announced the transferral of Dr. Josef Gaensheimer from the company's basic research group in Germany to the Stamford, Conn., laboratories. Dr. Gaensheimer will be concerned with the quality control and new product development phase of Molykote lubricants.

Houghton Expands Detroit Plant

Announcement by E. F. Houghton & Co., oil, chemical and packing manufacturers, Philadelphia, of expansion of its manufacturing facilities in Detroit, more than doubling the plant size, was made by William F. MacDonald, president.

Plans have been drawn and bids are being obtained for new factory, office and laboratory space adjoining the present location at Lumpkin Ave. and Detroit Terminal R. R.

The company plans to manufacture in Detroit practically the same oil and chemical specialty line now being made in the Chicago, Philadelphia and San Francisco plants. This will include lubricants, rust preventives, forging agents, cutting fluids, drawing compounds and fire resistant hydraulic fluids. Solvent type blends and additive treated oils will be supplied from the new plant, in addition to heat treating

Continued on page 48

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Previews . . .

NLGI ANNUAL MEETING

A special feature of the NLGI Technical Committee meeting in October will be a symposium entitled, "Fundamental and Practical Aspects of Bleeding of Lubricating Greases." The symposium, which is being organized by Messrs. J. L. Dreher of California Research corporation and M. J. Pohorilla of Kendall Refining company, will consist of five papers, followed by a selected number of prepared discussions, and an open discussion from the floor. All that is known about bleeding should be brought out during the symposium, and it is hoped that the audience will come prepared with questions about bleeding for the experts on the panel to answer.

The tentative titles of the papers, authors, and brief abstracts, are given below:

Research

Summary of Study of Bleeding of Lubricating Greases—Conducted by ASTM Technical Committee G-IV under chairmanship of Mr. B. B. Farrington—The study consisted of the following investigations: (1) factors affecting bleeding, such as pressure, tension, temperature, and vibration, (2) oil migration, and (3) storage and laboratory tests. The summary will be presented by Mr. J. L. Dreher of California Research corporation.

Tensive Stresses on Lubricating Greases Reduce Bleeding—Dr. D. W. Criddle, California Research corporation—Tensive stresses reduce or stop the bleeding of oil from lubricating greases. Data on this effect are presented for 25 greases. Bleeding tests are analyzed in terms of tensive as well as compressive forces; this analysis helps explain the poor agreement among bleeding tests.

Military

Grease Bleeding—Cause and Effect—S. Fred Calhoun, Rock Island Arsenal laboratory—The experience of the Ordnance department with greases which bleed excessively is described. The results of a study of the problem are presented which lead to the development of Federal Standard 322T. Included also are the effects of oil loss upon the grease properties.

Steel Industry

Factors Affecting the Bleeding and Separation Characteristics of Greases and Their Evaluation—Mr. J. S. Aarons, National Tube division of U. S. Steel corporation—Laboratory tests used at U. S. Steel lubricants testing laboratory are described. A summary of grease bleeding experience in actual mill operation is given and a correlation between test results and mill experience is shown.

General Industry

Long Time Bleeding Characteristics of Greases—Mr. A. E. Baker, General Electric company—Bleeding characteristics of petroleum, silicone, diester, and polyglycol greases are reported at several temperatures for extended periods of time. An equation is derived by which the effect of time on the bleeding rate of a given grease can be generally predicted. Some observations about the relation between bearing life and the bleeding rate of the grease are made.

Edgewater Beach Hotel Chicago October 28-30

Houghton Expands

Continued from page 46

salts, carburizers and quenching oil now made there.

The enlarged plant is made necessary, Mr. MacDonald stated, by the increasing demands which industry in that area, particularly automotive and parts plants, have made for Houghton products and service.

Ground will be broken in June and the plant is expected to be ready for manufacturing before the end of 1957. Between the old and the new plant, a fully equipped laboratory will be provided for control and customer service.

Served by a freight siding and by motor trucks, prompt deliveries in the Detroit area will be assured. A lot 360 feet long beyond the building provides necessary drum storage and driveway facilities.

George P. Wilson, present superintendent, will be in charge locally under the direction of Dr. James T. Eaton, vice-president, production. H. E. Martin, Detroit sales manager, has offices in the Stephenson building housing Houghton sales and service engineers.

Houghton Publishes Metals Surface Treatment Book

An eighty-four-page booklet describing the latest developments in the surface treatment of metals is now available to industry from E.F. Houghton & Co.

The recently published handbook covers rust prevention, mechanical and chemical cleaning, blackening, phosphating and other aspects of the field of metal surface treatment.

Various treatment processes are diagrammed, or illustrated photographically. A complete listing of the Houghton products available for surface treatment is also presented.

Write to E. F. Houghton & Co., 303 West Lehigh Ave., Philadelphia 33, Pa., for "Surface Treatment of Metals."

Sonneborn Opens New Laboratory

Research facilities were doubled at the Petrolia, Pa. refinery of L. Sonneborn Sons, Inc., New York, when a new laboratory building was officially opened recently. Called the Breth Laboratory, the new building was dedicated by Sonneborn president R. G. Sonneborn to the late Ferdinand W. Breth, technical director of the company for many years.

The new facilities will extend the company's efforts in four major product fields: white mineral oils, petroleums, microcrystalline waxes and petroleum sulfonates. A pioneer in the United States production of white oils, Sonneborn has increased its production of these oils at least 50% every ten years.

Rheem Expands With Pacific Plant

Rheem Manufacturing Co. will build a steel container manufacturing plant on a five-acre site pur-

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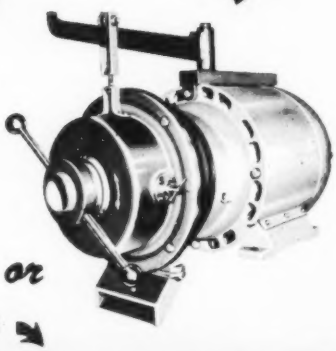

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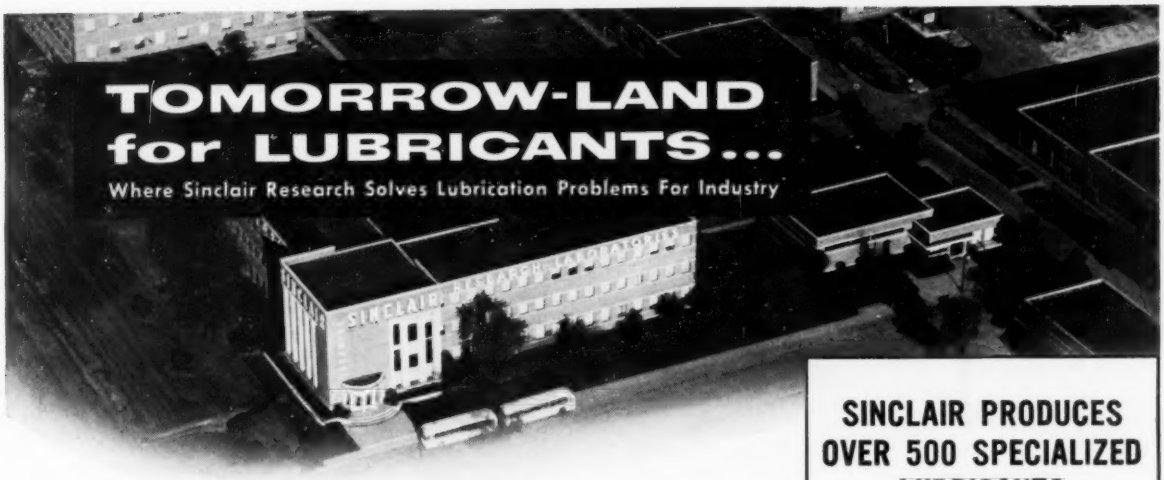

Located at Harvey, Illinois, is one of the most extensive installations of its kind in the world—Sinclair Research Laboratories. These facilities are an important part of Sinclair's investment in the future. Here is where Sinclair engineers and chemists work to develop new products and improve the quality of existing ones. At these famous laboratories were developed the Sinclair lubricants now solving difficult problems in all branches of industry. If you have a special lubrication problem, write today to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y.

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chased recently in the Port of Tacoma Industrial Tract, it has been announced by E. F. Paquette, container division vice president and general manager, at Linden, N. J.

Production of drums for petroleum, chemical and other industrial processors and customers in the Pacific Northwest is scheduled to start at the new facility in the fall, he said. The plant will include 18,200 square feet of floor space.

API Lubrication Committee Reports New Type Gear Lubricant

A report submitted by the Lubrication Committee of the Division of Marketing, American Petroleum Institute, notes that a new type gear lubricant has been developed having adequate load-carrying ability and other required properties to protect hypoid gears in sustained high speed and/or high torque service in modern passenger cars.

The Lubrication Committee reported that this new higher quality lubricant is expected to be adopted later this year by the military, and the automotive and petroleum industries, and will supercede present multi-purpose gear lubricants of the MIL-2105 level.

The designation approved by the Lubrication Committee for the new lubricant is Multipurpose-Type Gear Lubricant (API Service GL-4). Probable use of the designation will must likely begin with the 1958 passenger car owner manuals, and by the oil industry.

Wayne Pump Co. Presents New Double Action Pump

Wayne Pump company of Ft. Wayne, Indiana, has just introduced a new double action push-

Continued on page 50

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Wayne Pump

Continued from page 49

pull hand pump specifically designed for dispensing kerosene, alcohol, anti-freeze, lube oils and light greases. The pump is geared for accurate delivery in small quantity sales. Called DD-1, it assures cleaner, safer work areas. It is available as a pump only, a barrel pump or as a pedestal pump. It fits standard drum openings and can be had with either a standard cast spout and drip pan or a no-drip spout. Pump assembly weighs only six pounds. Wayne suppliers have it locally, or write Wayne Pump company, Ft. Wayne, Indiana.

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Newly Developed Ross Mixers Now Ready In 1 to 150 Gallon Size

A new series of heavy duty changeable can mixers, precision engineered to develope the greatest shearing and dispersing action in mixing paste materials, has been developed by Charles Ross and Son company. Available in sizes from 1 to 150-gallon working capacities, they employ intensive double planetary mixing action whose efficiency reduces mixing time to a minimum.

In these double planetary change can mixers, each stirrer revolves on its own axis, while both are revolved at a slightly slower speed around can. Close clearance between stirrers themselves, and between stirrers and can, produce twelve points of intensive compressive and shearing action during each revolution.

Mixers feature simplified vertical hydraulic lift for greatest ease in cleaning down stirrers, and non-rotating can is completely enclosed during mixing for maximum safety, while retarding creation of dust or evaporation of solvents. Cover has hinged observation or charging port and includes a detachable spout for safe adding of materials during mixing.

For greatest versatility in operation, wide range of stirrer speeds can be obtained by merely turning handwheel at back. Dolly truck, outlet gate, jacketed can, tachometer and self-adjusting floating-type outer scraper arm are optional extras.

Products Development Laboratory Moves

Mr. Alberic T. Di Masi, director of the Products Development laboratory has announced the removal of it's offices and facilities to new and larger quarters at 117 Pettaconsett avenue, Cranston, Rhode Island. Quarters were formerly located in West Warwick, R. I.

New Publication for Shell Oil Marketers

Shell Oil company has started a new publication. It is called *The Shell Retailer* and is distributed to retailers and jobbers and to employees in the company's marketing department.

The four page, tabloid size paper is edited by John Earl Davis, who edits *Shell Progress*, the company's bi-monthly magazine for service station dealers.

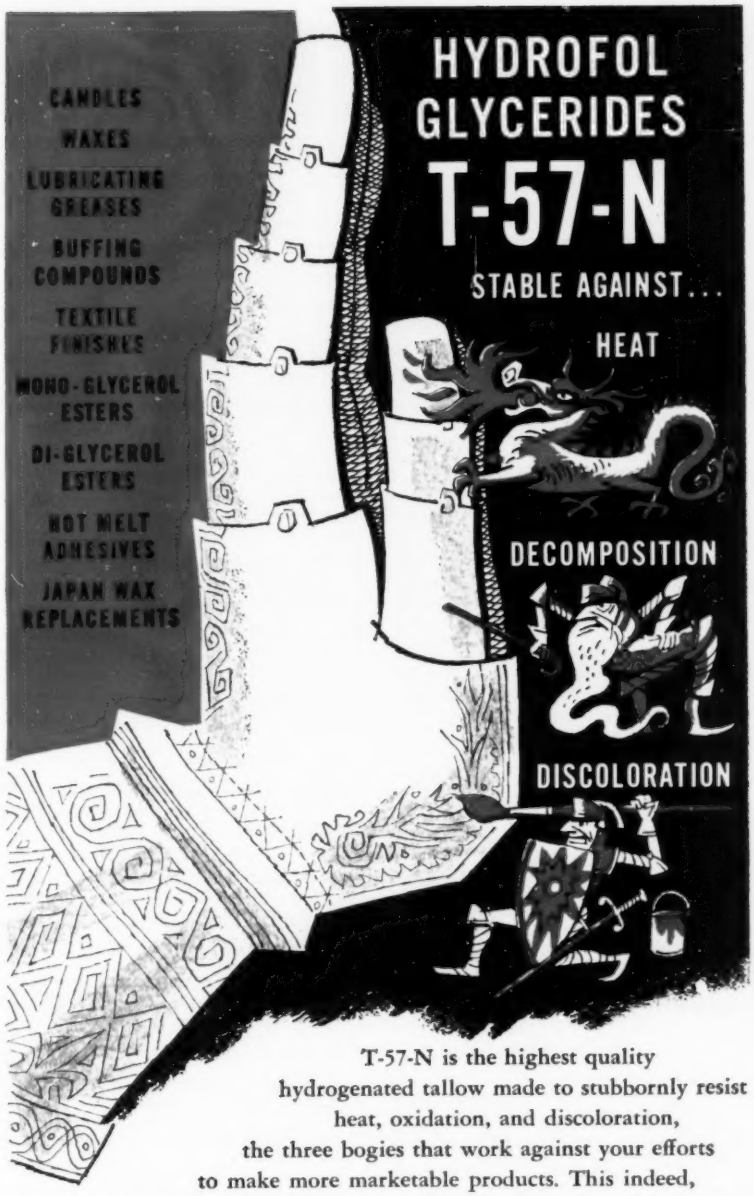
The lead editorial in the first issue of *The Shell Retailer* says the publication is designed to meet a need for more current information about issues concerning everybody connected with the oil industry—"information that cannot be fitted into the magazine."

One of the features in the first issue? Advice on how to service 1957 models with noisy ball joints, and the proper application of lubricating grease at said point.

Reaser Assumes ASME Duties

Professor William E. Reaser has left the faculty of engineering at Princeton university to accept appointment as assistant secretary of the American Society of Mechanical Engineers, it has been announced by William F. Ryan, ASME president. Responsibilities of this office encompass the relations with the membership in the sections throughout the United States, Mexico, Canada and Hawaii. An important phase of these activities is the work with students and recent graduates of the more than one hundred and forty American colleges and universities which have accredited mechanical engineering curricula.

Reaser was graduated from Lafayette College in 1930 and was awarded the degree of Master of Science by Lehigh university. In addition to considerable industrial experience, he taught engineering for a number of years at Lafayette college and Swarthmore college before joining the faculty of Princeton in 1952. He has been engaged as both an education and industrial consultant.



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2nd & Mallinckrodt Sts., St. Louis 7, Missouri
Representative—D. B. Batchelor

N. I. Malmstrom & Company
147 Lombardy St., Brooklyn 22, New York
Representative—Ivar Wm. Malmstrom

The McGean Chemical Corp.
Midland Building, 101 Prospect Ave., N. W.
Cleveland 15, Ohio
Representative—W. A. Ritchie

Metasap Chemical Corporation
Harrison, New Jersey
Representative—O. F. Lohrke

Monsanto Chemical Company
800 North Twelfth Blvd., St. Louis 1, Mo.
Representative—J. W. Newcombe

National Lead Company
Baroid Sales Div., 111 Broadway, N.Y. 5, N.Y.
Representative—H. H. Farnham

Newridge Chemical Company
7025 West 66th Place, Chicago 38, Illinois
Representative—T. E. Shine

M. W. Parsons—Plymouth, Inc.
59 Beekman St., New York City 38, New York
Representative—Herbert Bye

Synthetic Products Company
1636 Wayside Rd., Cleveland 12, Ohio
Representative—Garry B. Curtiss

Swift & Company
165th & Indianapolis Blvd., Hammond, Ind.
Representative—F. H. Beneker

Vegetable Oil Products Co., Inc.
Vopcolene Division
5568 East 61st Street, Los Angeles 22, Calif.
Representative—C. F. Williams

Witco Chemical Company
6200 West 51st St., Chicago 38, Ill.
Representative—E. F. Wagner

TECHNICAL AND RESEARCH ORGANIZATIONS

American Lithium Institute, Inc.
P. O. Box 549,
Princeton, New Jersey
Representative—Marshall Sittig

Battelle Memorial Institute
505 King Avenue, Columbus 1, Ohio
Representative—S. L. Cosgrove

Inland Testing Laboratories
6401 Oakton St., Morton Grove, Ill.
Representative—Dr. Morton Fainman

Institut Francais du Petrole
CMrR—Courtel, 4 Place Bir Hackeim
Rueil—Malmaison (S. et Oise) France

Les Laboratoires de Recherches Purfina
98/100 Chaussee de Vilvorde,
Bruxelles, Belgium
Representative—R. Gillerot

National Rosin Oil Products, Inc.
1270 Ave. of the Americas, N.Y. City 20, N.Y.
Representative—Richard Bender

Petroleum Educational Institute
9020 Melrose Avenue, Los Angeles 46, Calif.
Representative—G. A. Zamboni

Phoenix Chemical Laboratory, Inc.
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Future Meetings

AUGUST, 1957

12-16 Society of Automotive Engineers, National West Coast Meeting, Olympic Hotel, Seattle, Wash.

18-23 National Congress of Petroleum Retailers, 11th annual session, Sheraton Gibson Hotel, Cincinnati.

SEPTEMBER, 1957

9-12 Society of Automotive Engineers, national tractor meeting and production forum, Hotel Schroeder, Milwaukee.

10-11 Petroleum Packaging Committee, Point Edward, Ontario, Canada.

11 API Division of Marketing, Lubrication Committee meeting, the Traymore Hotel, Atlantic City, N. J.

11-13 National Petroleum Association (55th annual meeting), Traymore Hotel, Atlantic City, N. J.

18-19 Ohio Petroleum Marketers Association Fall Conference and Golf Tournament, Commodore Perry Hotel and Heatherdowns Country Club, Toledo, Ohio

22-24 Independent Oil Compounders Association Tenth Annual Meeting, Carter Hotel, Cleveland, Ohio.

22-25 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.

23-25 ASME, Fall meeting, Statler Hotel, Hartford, Conn.

26-27 Western Petroleum Refiners Assn., regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

30-Oct. 2 American Oil Chemists' Society (1957 Fall meeting), Netherland Plaza Hotel, Cincinnati.

OCTOBER, 1957

1-2 Texas Mid-Continent Oil & Gas Assn. (38th annual meeting), Texas Hotel, Fort Worth.

1-5 SAE National Aeronautic Meeting, Aircraft Production Forum, and Aircraft Engineering Display, The Ambassador, Los Angeles, Calif.

6-10 ASTM Committee D-2 meeting, Sheraton-Park Hotel, Washington, D. C.

7-9 ASME, ASLE-ASME Lubrication Conference, Royal York Hotel, Toronto, Ont.

7-11 American Institute of Electrical Engineers (1957 Fall general meeting), Morrison Hotel, Chicago.

9-12 SAE National Tractor Meeting and Production Forum, Hotel Schroeder, Milwaukee, Wis.

10-12 ASME, Fuels-AIME conference, Chateau Frontenac, Quebec City, Que.

13-16 API Division of Refining (midyear meeting), Penn-Sheraton Hotel, Philadelphia.

14-16 API Division of Marketing, Operations and Engineering Committee meeting, Biltmore Hotel, Los Angeles.

28-30 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

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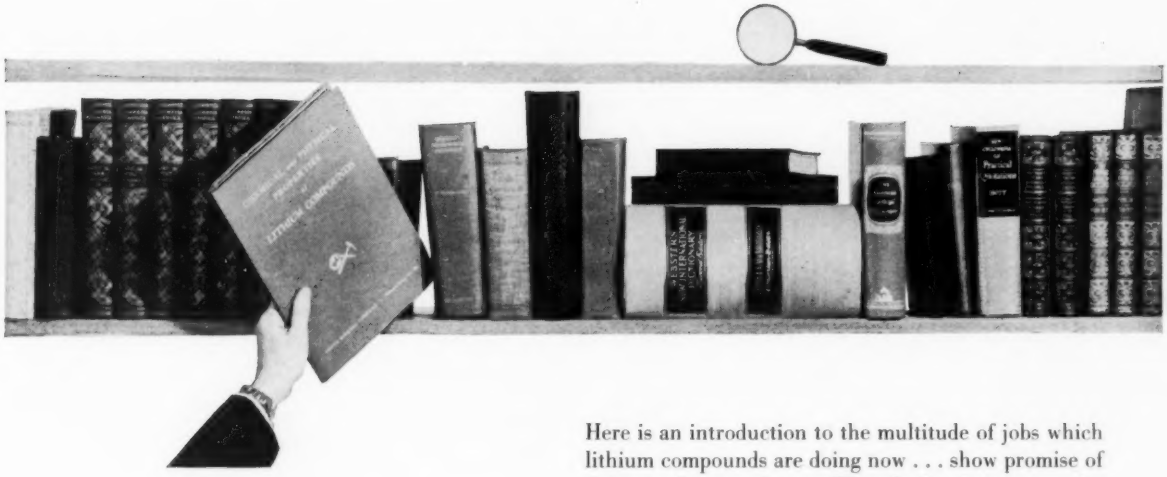

A DICTIONARY OF USES FOR LITHIUM CHEMICALS

past . . . present . . . future

Here is an introduction to the multitude of jobs which lithium compounds are doing now . . . show promise of doing in the near future. Though there's no space for them here, there *are* further details . . . and they *are* available. Let us know which compound or which job you're interested in, and we'll send you whatever data Foote has relating to your field of interest. Write the Technical Literature Department, Foote Mineral Co., 402 Eighteen West Chelten Building, Phila. 44, Penna.

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absorbent (CO_2): lithium hydroxide

air conditioning: lithium bromide; lithium chloride; lithium chromate; lithium molybdate

baths (heat treating): lithium fluoride; lithium chromate

battery (alkaline electrolyte): lithium hydroxide monohydrate

catalyst (crystal formation, esterification): lithium carbonate

catalyst (polymerization; reduction): lithium metal

ceramic (enamels, frits, glazes, etc.): lithium carbonate; lithium chloride; lithium fluoride; lithium nitrate

ceramic (raw material) lithium carbonate; lithium fluoride; lithium hydroxide monohydrate; lithium borate

coating (lens): lithium fluoride

coating (welding rod): lithium carbonate

conductivity* (increasing of electrolytes, fused salts): lithium chloride

coolant: lithium chloride; lithium metal

corrosion inhibitor: lithium bichromate dehydrate

cosmetics: lithium stearate

crystals (optical): lithium fluoride

dehumidifier: lithium chloride

de-icer: lithium chloride

dispersing agent: lithium citrate

dispersion stabilizer (deflocculant, ceramic): lithium citrate

electrolyte: lithium hydroxide

explosive:* lithium chlorate; lithium nitrate; lithium perchlorate

fillers* (rubbers, plastics): lithium aluminum silicate

flux (ceramic): lithium fluoride

flux (soldering): lithium borate

flux (welding and brazing): lithium chloride; lithium fluoride

freezing point depressant: lithium chloride

fuel*: lithium hydride; lithium metal

grease: lithium hydroxide monohydrate; lithium stearates

heat (transfer medium): lithium chloride; lithium metal

mud* (oil well drilling conditioner): lithium phosphate

nuclear material*: lithium metal

oxidizing agent*: lithium bichromate dehydrate; lithium chlorate; lithium chromate; lithium perchlorate

pharmaceuticals (production of): lithium carbonate; lithium chlorate; lithium citrate; lithium metal

plating reagent: lithium citrate; lithium cyanide; lithium hydroxide

pyrotechnics*: lithium chlorate; lithium nitrates; lithium perchlorate

reducing agent: lithium hydride; lithium aluminum hydride; lithium borohydride; lithium metal

scavenger (metallurgical): lithium metal

solder (silver): lithium metal

suspension stabilizer: lithium citrate

* You may very well be the *first* to take advantage of this potential use for lithium compounds.

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RESEARCH LABORATORIES: *Beruyn, Penna.*
PLANTS: *Cold River, N. H.; Exton, Pa.; Kings Mountain, N.C.; Knoxville, Tenn.; Sunbright, Va.*

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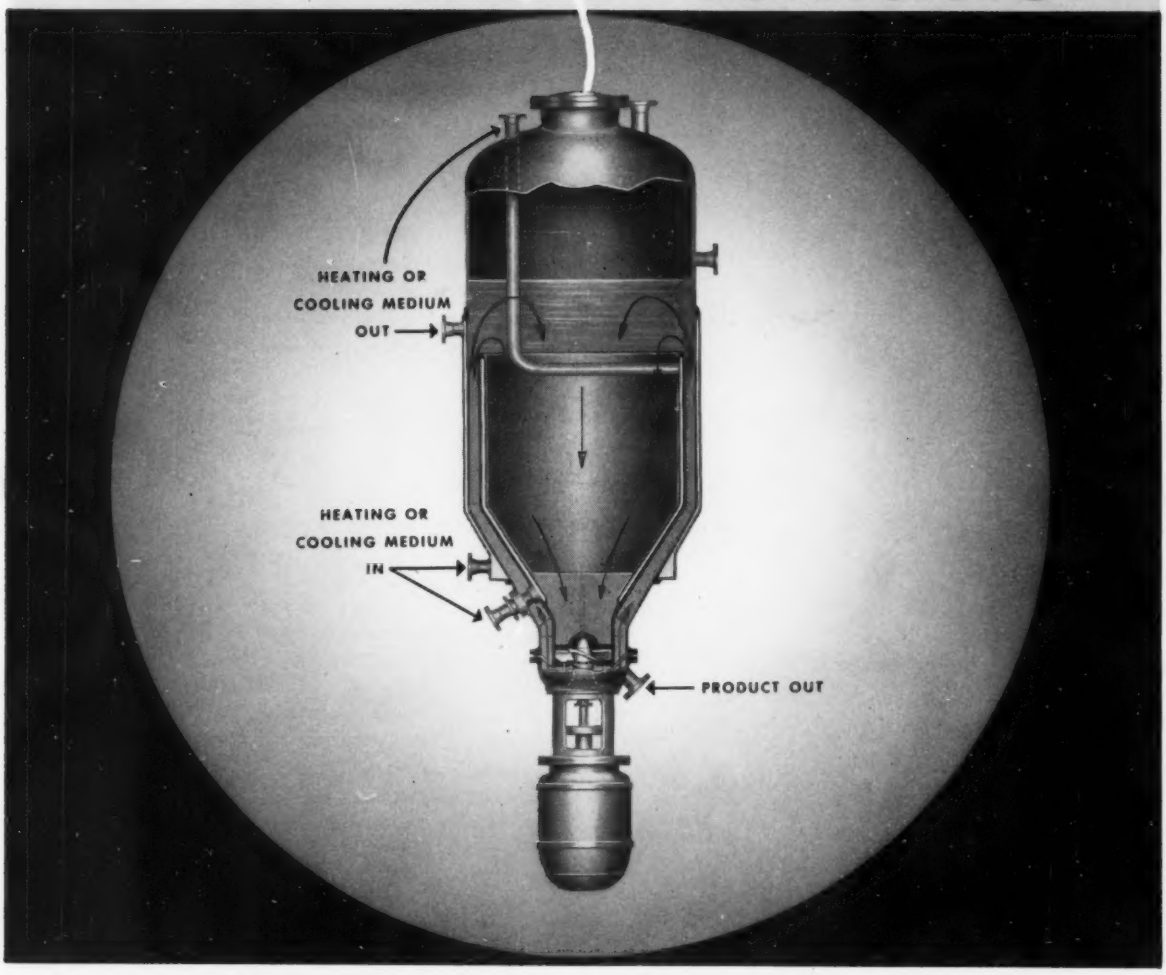

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